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Fighting Fire from the Sky

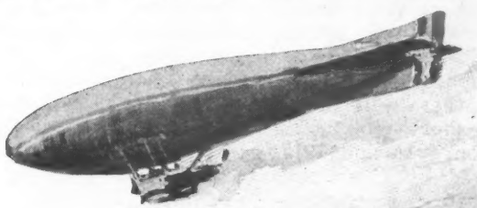
The forest ranger becomes an aviator

By Robert H. Moulton

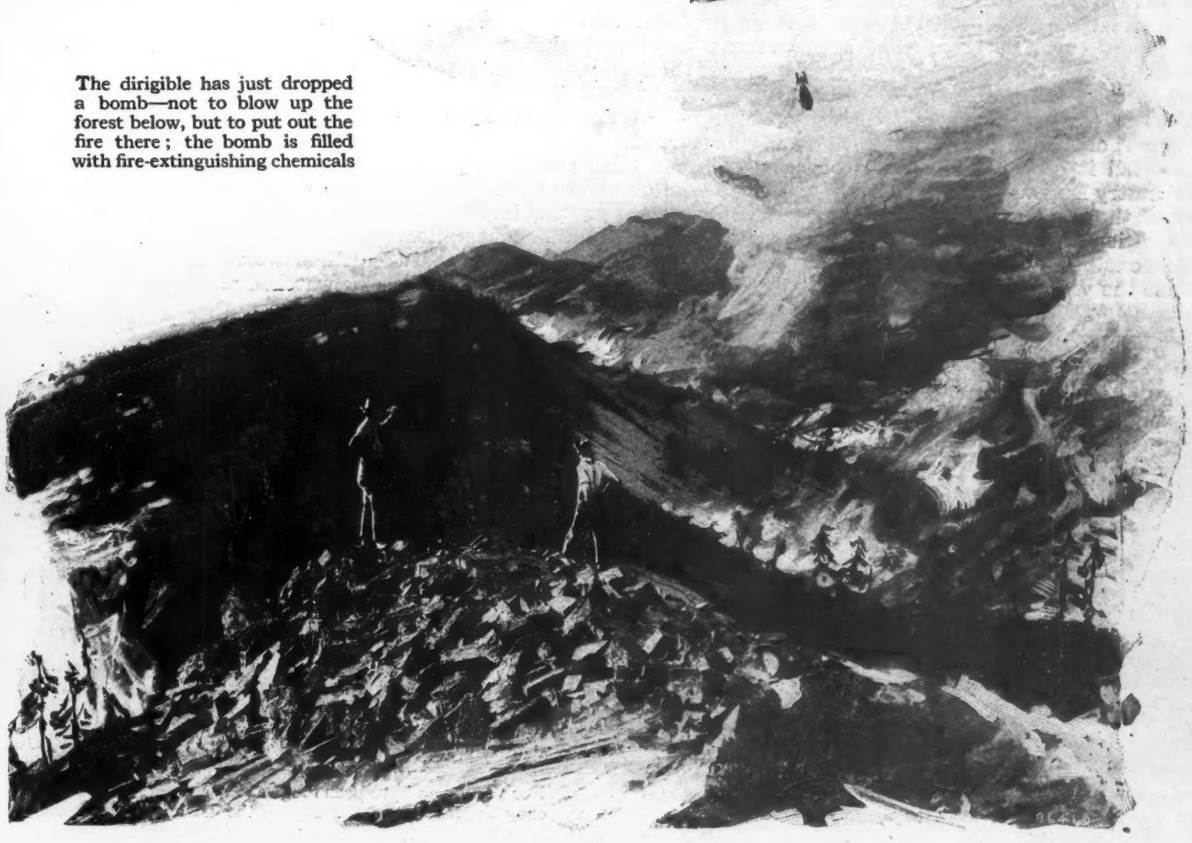
VISITORS to our national parks this summer have been considerably puzzled by the frequency with which airplanes and dirigibles have skimmed overhead. No reason for this activity was apparent, now that the war is over.

However, an excellent reason has existed: the flyers were acting as aerial patrols, watching for and reporting any forest fires they discovered. Thus Uncle Sam has found an important use for his aces of the air right here at home.

Heretofore the work of patrolling United States forests to locate and fight fires has been entrusted to men on horses, motorcycles, or railroad speeders, and partly to watchers stationed at lookout points. The former travel about from place to place, while the watchers, who are located at advantageous



The dirigible has just dropped a bomb—not to blow up the forest below, but to put out the fire there; the bomb is filled with fire-extinguishing chemicals



spots, usually on the top of some high mountain-peak, never leave their post, but remain constantly on the lookout for fires.

The observers at lookout stations are provided with all the latest scientific instruments for locating distant objects, and with carefully prepared maps showing the names of all canyons, streams, roads, ranger stations, and the like.

How the Watchers Do Their Work

These men have powerful field-glasses, and a telephone leads to the nearest ranger station and to the forest supervisor's office. If a fire is discovered, the watcher immediately telephones to headquarters, giving the location of the fire as it is projected on the map of the station; a crew of men is despatched to fight it.

The efficiency of this system has been increased from year to year, until now it is as up-to-date and as successful, in its own field, as that of a municipal fire department. In fact, the same essential factors for success are employed in the forest work that are universally recognized as necessary for fighting fires in cities: namely, first, detection of the blaze before it has gained headway; and, second, prompt attention.

According to reports compiled by the Forest Service, there were in the United States an average of 28,735 fires a year between 1915 and 1917. The ground covered by these fires amounted to 8,052,945 acres. The estimated damage was $9,875,000.

A report covering the period between 1913 and 1917 showed a yearly average of 6,184 forest fires, with 666,663 acres burned and damage to the extent of $599,000.

Last fall it occurred to officials of the Forestry Bureau to supplement the work of the regular forest rangers by the addition of air scouts, and a few experimental flights were made to determine the value of the airplane and dirigible in this connection. These experiments proved so satisfactory that Secretary Baker issued an order directing the Air Service to cooperate with the Forest Service in the work of forest fire patrol, and, beginning with the first of June, the plan was regularly put into operation.

Air scouts and bombers who saw service in the Great War were set to work in the forests; and dirigibles — filled with the new non-inflammable helium gas instead of dangerous hydrogen—will also be used in patrolling the forests for fire.

Airplanes and dirigibles will cooperate with the watchers at lookout stations; this watcher has before him a map of the forest, and near by there is a telephone, for use should he detect smoke

Reports received by the Forestry Bureau show that the airmen experience no difficulty in detecting fires in heavy timber at an elevation of ten thousand feet and even more. From this it will at once be evident what an advantage the air scout enjoys over the watcher in a lookout station. Even when these stations are located on mountain-tops, the range of the observer is more or less limited by reason of the character of the country cut by deep canyons and broken by mountain-ridges. Furthermore, the area of country that he can see at any time is always the same, whereas the airplane scout, flying swiftly at a much higher altitude, is enabled to cover a wide and ever-changing stretch of country within the space of a few minutes.

The aerial observer has still another advantage, of the greatest importance, over the watcher in the lookout station. The latter, when he has discovered a fire, can do nothing more than telephone its location to the nearest fire guard; he depends upon others to go to the scene and combat it. On the other hand, the air scout, when he has located a blaze, can send in the alarm, and then, swooping down over the spot, drop on it bombs charged with suitable chemicals for extinguishing fires. By this means he is frequently enabled to put out the fire unaided, or to check its growth until the regular fire-fighters have time to reach the place before it has gained any considerable headway. In this connection, a plan that is soon to be tried out proposes transporting fire-fighters in dirigibles from which ladders can be lowered to the ground.

Warnings Flashed by Wireless

The observer in a lookout station locates fires by means of triangulation, reports being telephoned from separate observation points. The air scout locates them by coordinates in the same way that gun-fire is directed to a particular spot or object—that is, by means of squares drawn on duplicate maps, one being in the possession of each airplane observer and another in the office of the forest supervisor.

The tentative plan is to equip the patrolling airplanes with wireless sets, with which the pilots may flash the first signals of fire. Roads and pathways where a carelessly thrown cigarette may be the cause of thousands of dollars' worth of damage will, of course, be watched particularly.

Regular war-time bombing planes are used; it is planned also to use dirigibles filled with the non-inflammable helium gas

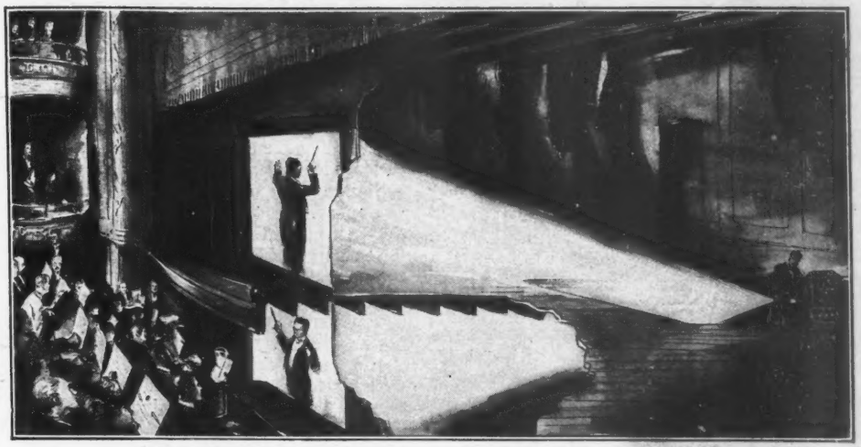
For years fires have been fought by crews of men alone; they chop down trees at the edge of the fire in order to check it

Putting Hinges in the Football Shoe

AT the quarter-back's signal for a run around right end, the half-back sets his shoe-calks into the earth and waits for the ball to be snapped back. But a husky guard on the opposing team breaks through, the quarter fumbles, and there is a wild scramble. The half-back swings in his tracks and dives into the middle of the struggling players. A moment later the referee's whistle sounds, the human omelet is unscrambled, and the half-back emerges with the ball.

A misstep in making the lightning-like change of direction might have put the half-back out of the game. It is to minimize such mischance that a Chicago firm has turned out a football shoe with a double-hinged ankle support. The shoe combines flexibility with perfect ankle support.

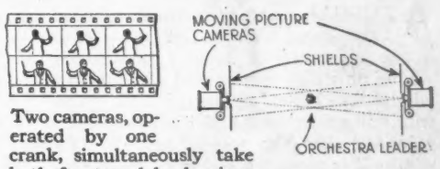
Hinges give it a freedom of movement impossible in a rigid shoe



A moving picture of a conductor in action leads the orchestra; at the same time the audience gets a view of the conductor's back

Immortalizing the Band Leader

IN the theater the orchestra tunes up, the lights go down—the play is about to start. Suddenly a moving picture of a man's back appears on a screen just in front of the orchestra-pit. It is a famous musical conductor; and while you look at his back, the orchestra sees him leading it.



Two cameras, operated by one crank, simultaneously take both front and back views

In taking a picture like this, the subject stands between two cameras facing each other and operated by one crank. From the two negatives thus made, one positive, such as is used in the projecting lantern, is made. The film is run off on a screen divided in two: the top view is translucent, so that the audience may see it.

Bringing the Pedals Up to the Feet

THE "do-re-mi-fa-sol-fa-mi-re-do" days of piano practice are the dreariest of all to the young pianist. In the first place, he (or she) would far rather be outdoors, playing; then, the scale itself is expressionless, and is rendered more so by the fact that his legs are not long enough for his feet to reach the pedals, reminding him of the fact that he is quite uncomfortable and undignified because his feet dangle aimlessly.

Yet all this trouble would be eliminated if the piano were equipped with one of Arthur P. Smith's "extension pedals." The pedals jut out of the top of a box that bridges the distance between feet and floor. By means of a screw-bolt and an arm that extends under the piano, the box is held in place. It is provided with cushions, so that it will not scratch either the floor or the piano.

The extension pedals are directly above the real pedals, and are so arranged that when they are pushed down the real pedals go with them and register "soft" and "loud." The extension pedals are provided with springs, so that they will rise back into place when the pressure is removed.

Her feet rest on a box that is equipped with extension pedals; thus she may play in comfort and with expression

Its One Fault

SOME time ago a traveler brought home to England a "Kaffir pick." It was a versatile tool, the natives using it as an ax, a pick, or a spade. It was shaped like a heart. A British manufacturer saw it, and decided he could make it and market it more cheaply than could the Kaffirs. He produced a pick so like the original that the Kaffirs couldn't tell the difference—so he thought.

Salesmen went forth to South Africa with their British-Kaffir picks, expecting a harvest. But, strangely, the harvest was not forthcoming; the picks remained on their shelves in the shops. Sadly the salesmen returned home—all except one. This tenacious one took a trip up country, talked to the Kaffirs, and learned what was wrong.

In addition to its other uses, it seems that the Kaffirs take the pick from its haft and use it as a cattle call, and they had discovered that the British-made article did not have quite the right note. The manufacturer quickly remedied this, and sales picked up.

When the Wind Blows, the Wagon Will Move

A ZIP-CAR race. Why are they called "zip"-cars? We haven't any idea; but a zip-car is a small four-wheeled wagon on which is mounted a cardboard windmill. When the wind blows the windmill goes round, and the power thus gained makes the wagon move. The windmill is mounted either in the direction of motion or else at right angles to it.

In this race it looks very much as if her wagon, which has eight sheets to the wind, will beat his wagon, which has only about four.

Since the zip-car is propelled by the wind, it might easily be called a sail-boat on wheels. The children seem to enjoy playing with these land boats as much as if they sailed on water—and in the case of the zip-car there is no chance of the children falling into the water and getting their nice clean clothes muddy.

Lock-Makers of Leipzig

BEHOLD! A parade that has nothing to do with Bolshevism or higher wages. This unusual occurrence took place in Leipzig, Germany, soon after end of the war. The men are sandwiched into large locks, and they carry in their hands signs on which more locks appear.

An indication of their desire to lock up the Kaiser? No; the lock-makers' section of the manufacturers' advertising parade. Before the war Leipzig had one of these parades every year; it was part of the annual fair. During the war these fairs were suspended; but now the people of Leipzig are having their fairs again.

A Bicycle Built for Two Elements

PERHAPS one hot day Mr. Jack Belbin, of London, England, wished he could ride his wheel in the Thames instead of along a dusty road, and of the wish was born the queer land and water craft with which he makes his fellow Britons stare.

His plan is simplicity itself. Fasten a float securely to each side of the bicycle, leaving room for the legs to make the pedals go around, put on rubber boots if you mind wet feet, then ride right into the water, and keep up your pedaling.

Of course you can't make much speed afloat, and unless you wear a bathing-suit it's best to choose a calm day for your spin in the water. We also suggest skid chains, for when you come out of the water dripping wet your wheel will have a tendency to slide sideways; and it is very likely to stay wet for some time.

Fording Streams in an Automobile

NO wonder the lady below leans anxiously over the edge of her car. All she sees is water, water everywhere—even on the road over which she rides. Will she have to jump out and swim? she wonders.

Such is automobiling in Jamaica; the roads are often under water. But the explanation is simple. Jamaica is an island about one hundred and forty-four miles long and only fifty miles in breadth; yet on the island there are as many as one hundred rivers and streams, which empty into the sea and have their sources in the mountainous interior. At flood-time these many rivers overflow their banks and often cover the roads completely, causing much inconvenience.

The mountains of Jamaica run as a sort of backbone down through the center of the island. This backbone, together with the general outline of the island, makes it look like a huge turtle rising out of the sea.

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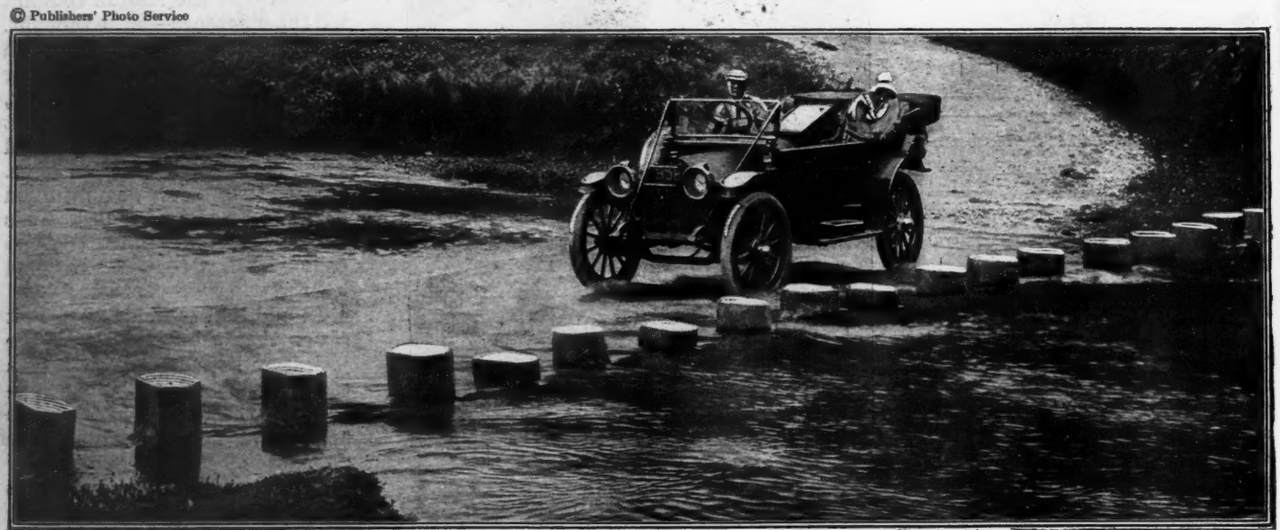
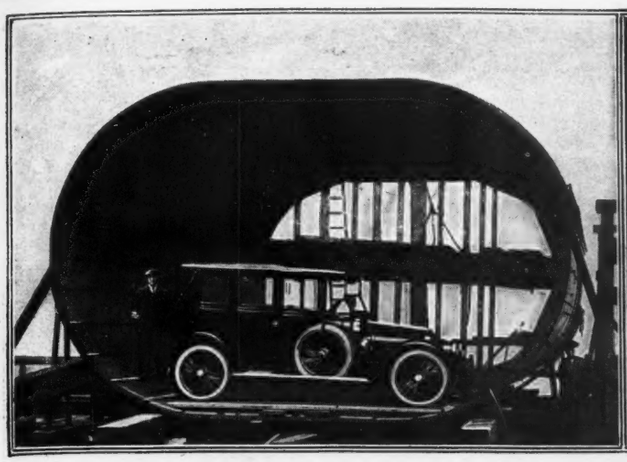
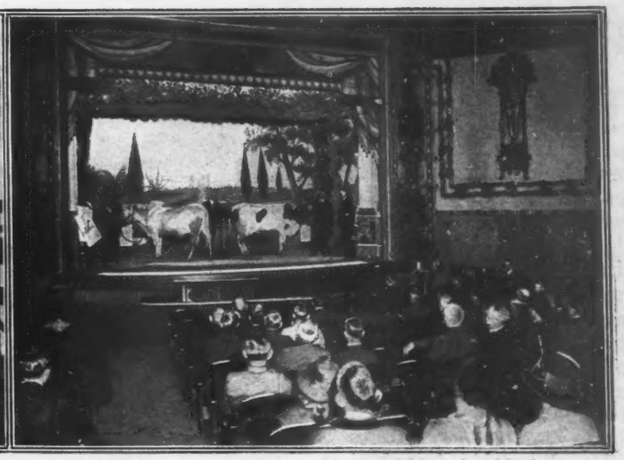






The Funnel's the Thing

IT looks very much as if the limousine above were going to try to ride up the side of the tunnel-like structure in which it stands. But that is no stunt for a new limousine to try.

The car is being used merely to bring out the size and strength of a section of a battleship funnel. The funnel had just been completed, and was planned for use on the battleship *Almirant Latorre*, built for the Chilean government.

What we are wondering about is how the car got in, and how it will get out again. There seems to be little room for it to maneuver in, and no road for it to follow when it does turn around.

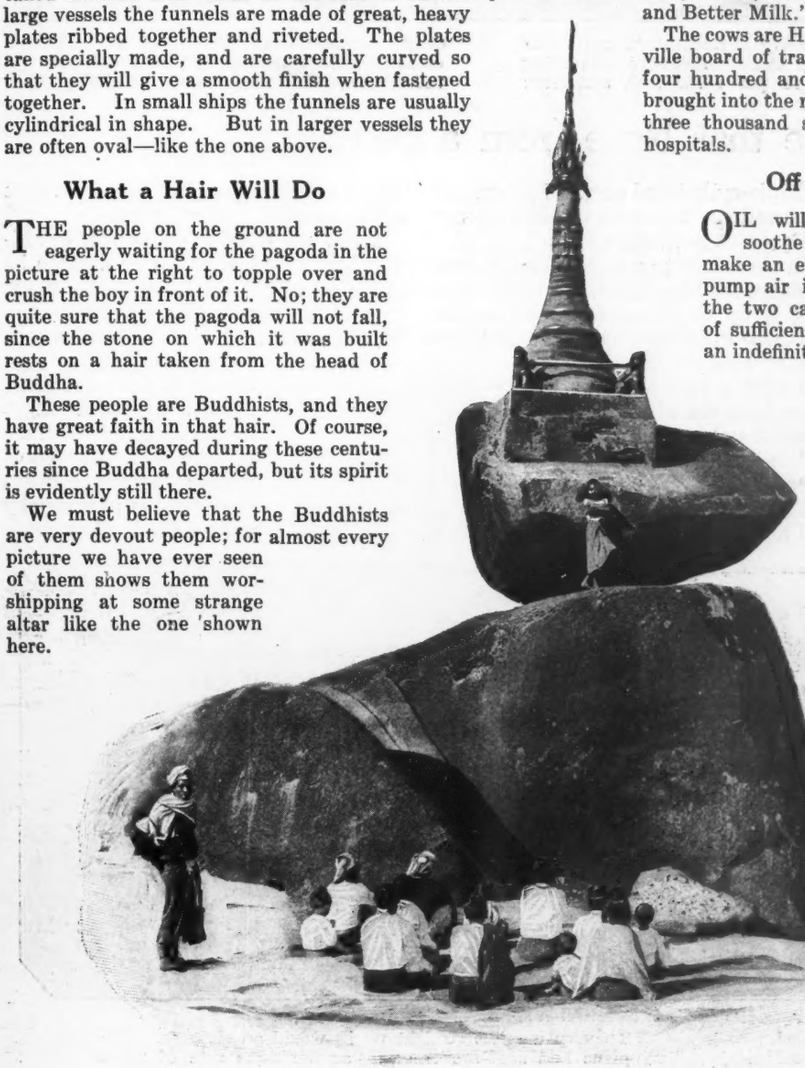
Funnels on small ships are usually made of sheet-iron—often called Russian iron. But in the case of battleships and other large vessels the funnels are made of great, heavy plates ribbed together and riveted. The plates are specially made, and are carefully curved so that they will give a smooth finish when fastened together. In small ships the funnels are usually cylindrical in shape. But in larger vessels they are often oval—like the one above.

What a Hair Will Do

THE people on the ground are not eagerly waiting for the pagoda in the picture at the right to topple over and crush the boy in front of it. No; they are quite sure that the pagoda will not fall, since the stone on which it was built rests on a hair taken from the head of Buddha.

These people are Buddhists, and they have great faith in that hair. Of course, it may have decayed during these centuries since Buddha departed, but its spirit is evidently still there.

We must believe that the Buddhists are very devout people; for almost every picture we have ever seen of them shows them worshipping at some strange altar like the one shown here.



"More and Better Milk"—the New Drama

IF memory serves, it was in "Evangeline" that the domestic cow first made her appearance on any stage—and the cow was only a calf at that.

But nowadays the cow and her husband are getting into all sorts of places. Not long ago we showed a gentleman and lady cow of blue-ribbon pedigree gracing a bank to help out a Liberty Loan drive.

We just missed preserving for history the photograph of a prize bull that had a suite at the Waldorf-Astoria (he registered and left between editions); and now we hasten to present two cows doing a sister act on the stage of a theater at Asheville, N. C., where they appeared in a piece entitled "More and Better Milk."

The cows are Holsteins imported from Wisconsin, and the Asheville board of trade reports that as a result of staging the cows four hundred and fifty-eight head of Holstein cattle have been brought into the mountain country, where their milk is needed for three thousand sick and wounded soldiers in the government hospitals.

Off for a Swim with Two Oil-Cans

OIL will calm the troubled waters, and oil-cans will soothe the would-be swimmer. For two oil-cans will make an excellent life-preserver. You empty the oil out, pump air into the cans and plug up the holes, then tie the two cans together. They act as water-wings, and are of sufficient buoyancy to hold up a grown-up person for an indefinite length of time.

Of course, when the cans hit each other they make the usual tin-can racket; but then, it's a good idea to make yourself conspicuous when you are swimming in deep water.

The girl that smiles in our illustration upholds the oil-cans that are obviously upholding her.

Though oil-cans tied together resemble the customary water-wings made of cloth, they are really much safer. The air in water-wings is bound to ooze out gradually because of the porous condition of cloth. Thus a person can use them for but a limited amount of time. Such is not the case with tin.

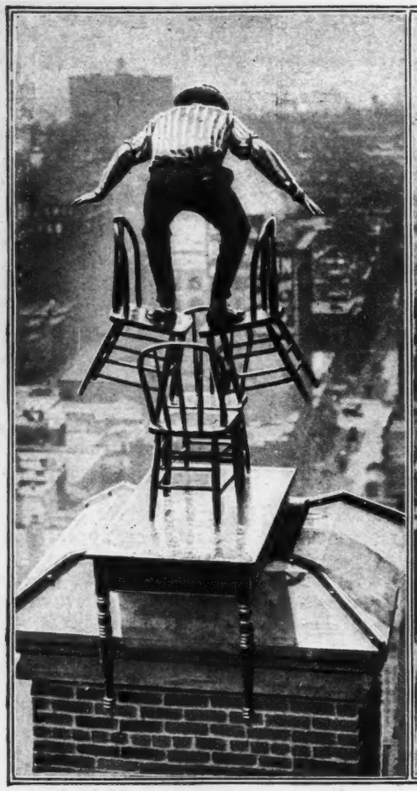
Try It on the Roof

"I CAN outdo Locklear or Law," said Mr. Jug Reynolds, a New York city daredevil; and he immediately betook himself to the roof of a twenty-two-story building, and did a shoulder stand on a kitchen chair placed precariously near the edge of a small table which rested on top of a chimney. A dangerous stunt, to be sure; but was it as risky as Locklear's drop from one airplane in flight to the top of another?

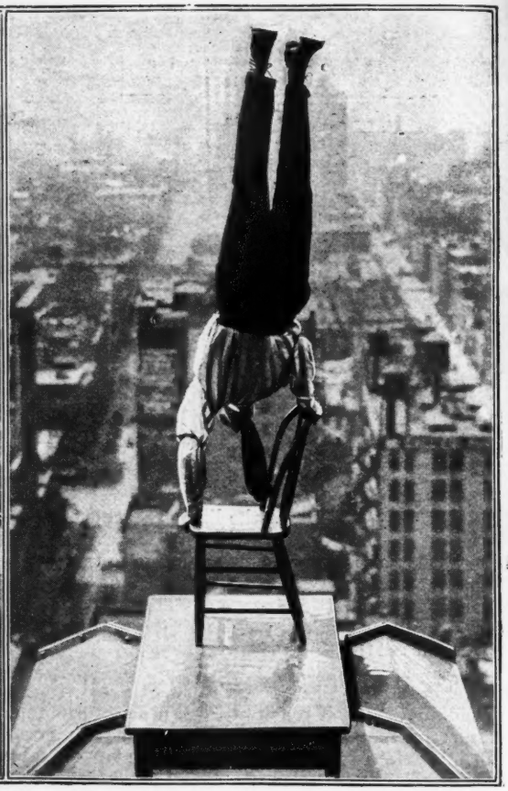
Mr. Reynolds feared that the spectators might not think so. Forthwith he climbed down, brought up three more chairs, and tried another stunt.

On the table he placed two chairs so that they touched each other face to face. He climbed up, and then placed the other two chairs so that their front legs rested on the edges of the lower chairs. And on top of this tower of table and chairs he stood and looked down at the street far below.

No vain boaster he!



Jug Reynolds said recently: "I can outdo Locklear or Law." And here he is trying his best to prove his rash statement



Only a daredevil would do a shoulder stand on a chair that stood on a table that rested on the chimney of a twenty-two-story building

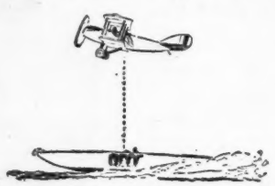
An Airplane that Rose from a Sea-Sled

OUR Navy, always doing something unusual, recently made the experiment of allowing an airplane to "take off" from a fast power boat going fifty miles an hour, and, as usual, got away with it, besides settling some questions concerning certain experiments.

The airplane, which had the usual wheeled launching and alighting gear, was lifted by a derrick and lowered into place upon the sea-sled, being simply chocked to hold it in position.

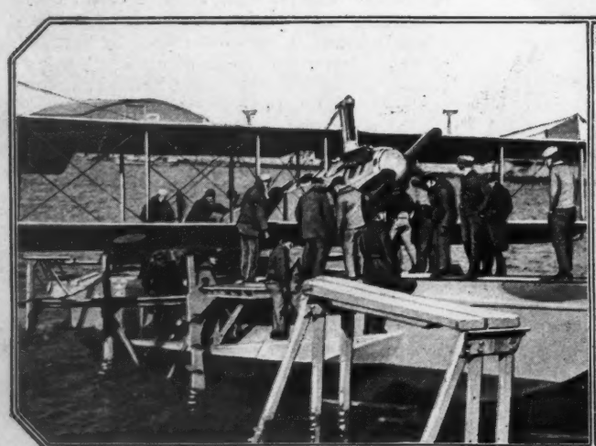
The sea-sled got under way, and taxied out into the bay, where her multiple-cylindered engine was opened wide and she began to tiptoe over the light sea at her best speed.

In obedience to a signal the airplane pilot started his engine, gradually running it up to the same speed as the boat was making. Then suddenly he opened wide the throttle, and with a roar the airplane took the air, going straight upward as if it had been thrown from a catapult.

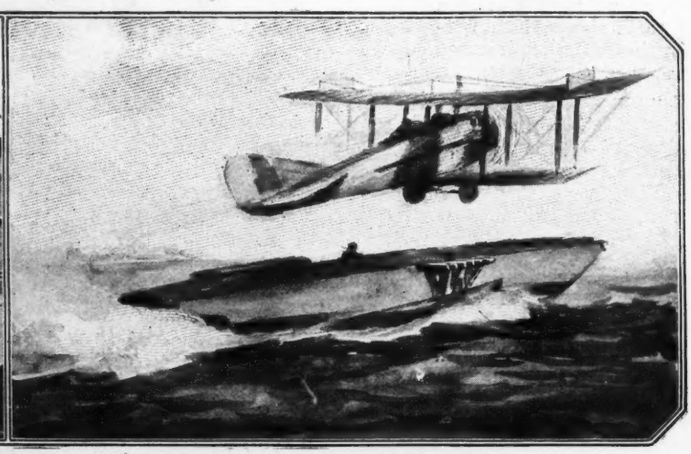


This was done again and again to satisfy the officers that it was not merely a case of luck at the first attempt.

Now, we wonder, could this experiment be reversed and the airplane be made to alight upon the sled while it was under way? We see no reason why it could not be done if some means were provided so that the airplane's pilot could gage his airplane to alight in exactly the place where it took off. But don't worry; this experiment is probably under way by now.—FRED G. JOPP.



The airplane being mounted upon the sea-sled, with the pilot in his seat, ready to "take off"



The airplane rises straight up as would an elevator. Airplane and boat are traveling at the same rate of speed

Photographs courtesy of the Pathé News Service

The poor little kangaroo hasn't much chance with this new terror pursuing it

Hunting the Kangaroo

The modern way is to track and shoot the animals, seated in a comfortable motor-car

By Earle W. Gage

THREE sturdy automobiles, each bearing several men armed with heavy army rifles, speed through the Australian landscape. They come from Adelaide, South Australia, and head northward toward the heart of the plain which extends in unbroken dreariness for hundreds of miles in that direction. The lookout in the leading car scans the horizon with a field-glass.

"There they are!" he calls out, pointing to a slight rise. The heads of a few kangaroos are plainly visible above the salt brush, which grows beyond Burra Burra, the jumping-off place of civilization.

The whirr of the engines must reach the animals' sensitive ears; for they take to flight with tremendous bounds. At a distance of three hundred yards they stop.

The automobiles continue in their wild rush over the rough ground, and now the hunters let their rifles speak.

One of the animals is wounded. The remainder of the herd, keeping well together, leap away in one direction, while the wounded animal hops with terrific speed in the opposite direction. The nearest car takes up the pursuit, and for three miles continues in its course, parallel to that taken by the wounded kangaroo. The brush becomes thinner and the hunters head their car in a straight line for the animal, which shifts its course to an angle that brings it directly across the path of the oncoming car. A well aimed shot ends the flight.

Now, back to the pursuit of the rest of the herd. After a drive of a few miles the animals are sighted. At a distance of fifty or sixty yards the hunters open fire, killing four of the animals. The fifth, a young kangaroo, takes to the open country. The hunters have decided to catch it alive. As they approach their prey, one of the hunters creeps forward on the running-board, seizes the kangaroo by the tail, and manages to hold on to both car and animal until the car is stopped.

Kangaroos in great numbers annually invade Australian ranches and destroy crops. Hunting them was formerly an almost hopeless undertaking, but now a day's hunt by automobile will frequently bag fifty or more

Each year, during the prolonged drought in the Australian bush sections, the kangaroo becomes a pest in the farming sections, great numbers invading the ranches and destroying the crops. Before automobiles were pressed into service, kangaroo-hunting was almost a hopeless job.

Why Is Rattan Built Up of Tubes?

ONE of the longest of all plants, perhaps the very longest when diameter is taken into consideration, is the rattan, a member of the palm family.

The rattan palm does not need intrinsic strength, because it gets its support by leaning on other plants. The porous or tubular character is found in most plants of its habit, and seems to serve the purpose of securing a large quantity of water through a comparatively small stem.

These large ducts give the stem, in cross-section, a cable-like appearance, though in the plant each one of the cable-like wires is a tube.

In other plants a tube might be employed for utilizing the material in the best possible manner for strength, as, for example, in the grasses, where the stems are hollow,

Its tubular character seems to serve the purpose of securing a large amount of water

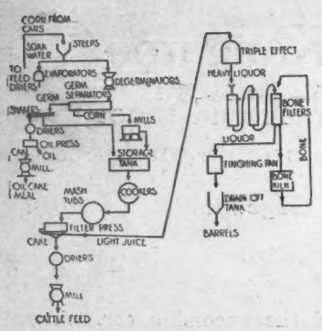
because the amount of material thus placed within the culm will give the greatest amount of stiffness.

In the rattan the smaller tubes have the reverse function. Perhaps, from the mechanical point of view, nature does not desire to gain either end.

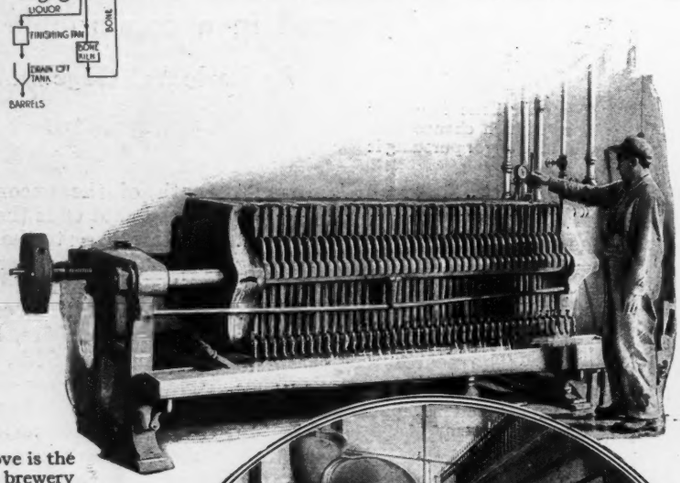
The result of the peculiar arrangement of the material is a remarkably flexible stem, so that rattan is well adapted for weaving and for various purposes in which extreme flexibility, together with strength, is desirable. It is also used extensively in the form of walking-canes, wicker chairs and other furniture, and thin strips of it are woven into mats for floor covering and sun curtains.

From Beer to Maltose

How one brewery managed to stay in business

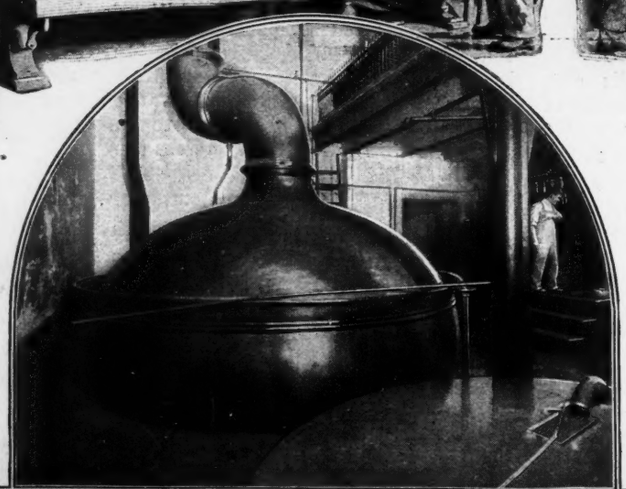


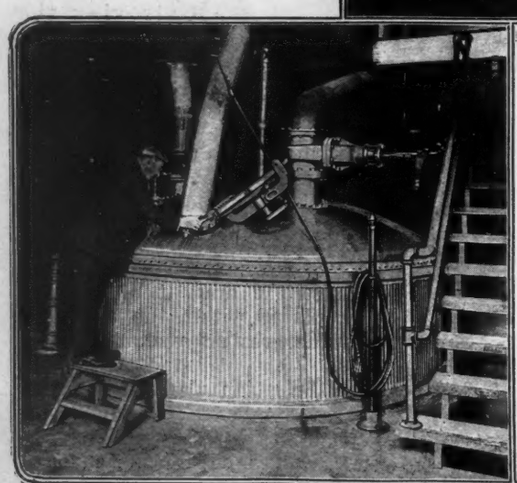
This is what the chemical engineers call a "flow sheet." It shows the way in which corn is converted into maltose, oil-cake meal, and cattle feed



To the right and above is the filter press that the brewery needs if it wants to make maltose. The press is used to clarify the juices that most of us now drink to slake our thirst. Maltose is bought not only by the soft-drink manufacturer but by the candy-maker and the bread-baker

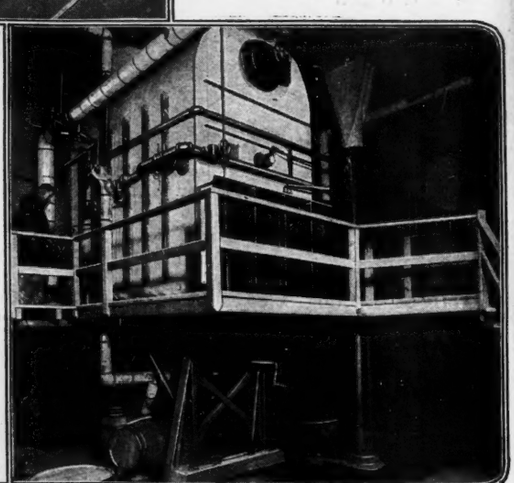
Oscar, the hero of this prohibition drama in pictures, is drawing off maltose sirup worth about one dollar a gallon. Even before prohibition was forced on us, there were ten thousand establishments engaged in making soft drinks, and most of them used quantities of maltose



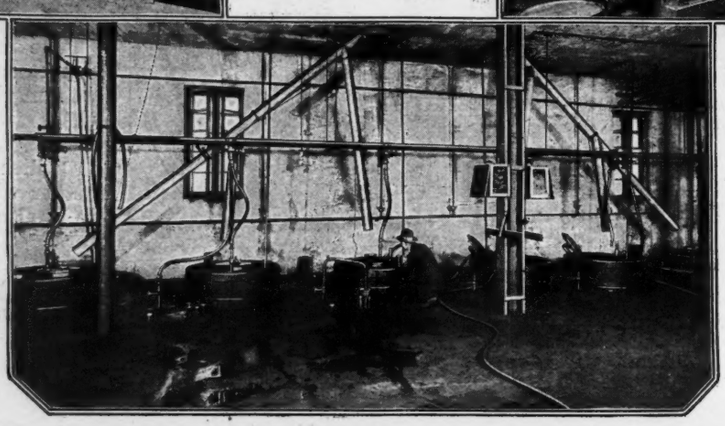


Now the vats and kettles store ginger-ale, and sirups that you drink in your cherry, lemon, strawberry, raspberry, orange, pineapple, grape, and phosphate soda. Since we've got to drink something, maybe the breweries will stay in business, after all

Bone filters must be installed in the reformed brewery if it is to make maltose from barley malt



The cooker used in converting the starch in corn and in barley into maltose, is the same that made beer. All bottled soft drinks contain water, flavor, sweetening, and sometimes carbon-dioxide gas. The breweries have most of the machinery required for making soft drinks

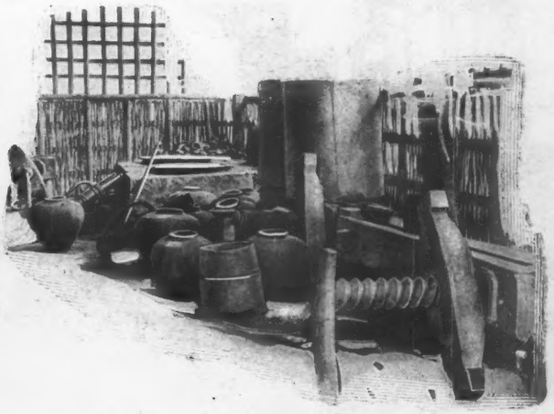


Here are the vacuum pans for the concentration of the light sugar solutions. Vacuum evaporators are additional equipment in the brewery. The apparatus required in brewing is complicated and expensive. Much of it is made of copper, and is adapted to delicate operations

After a Coconut Leaves the Tree

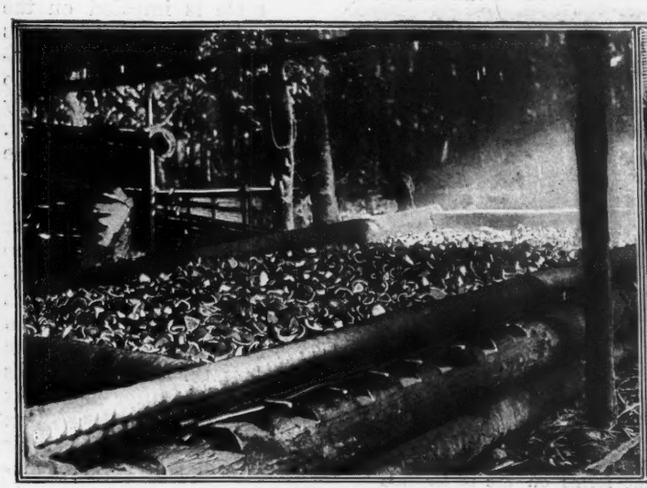
Its varied career, ending at last in a soap factory

You can't blame the monkeys for dropping coconuts on people's heads, the nuts are so plentiful. Each tree turns out sixty nuts a year—starting when it's five years old

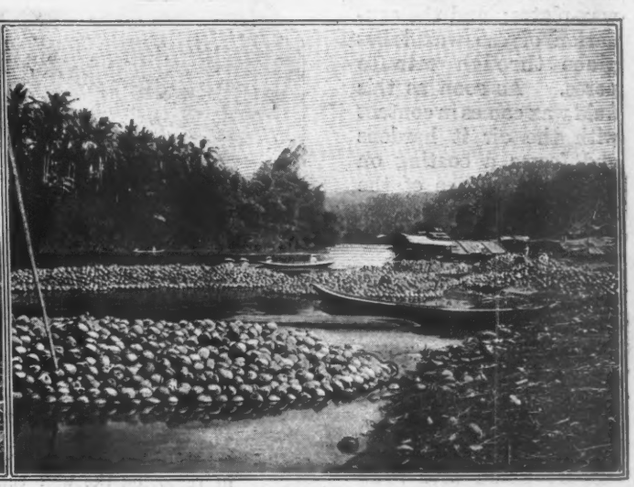


In the oil factory the coconuts are pressed or boiled. A thousand nuts yield twenty-five gallons of oil, which is used chiefly for making candles and soap

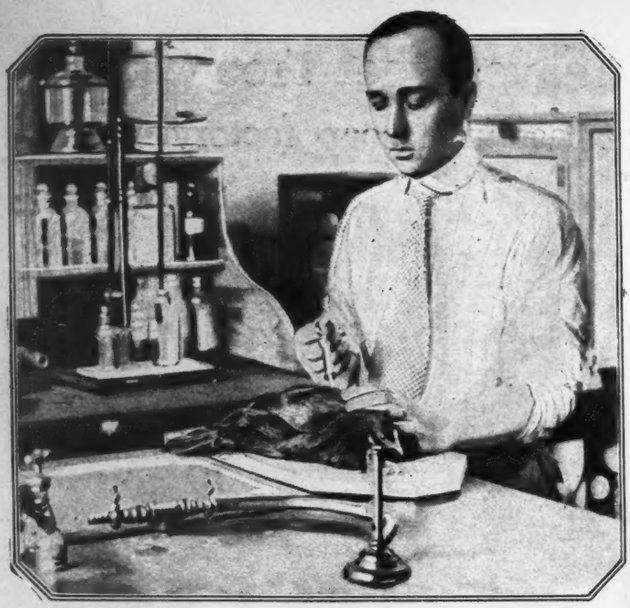
A sharp steel knife cuts the coconut in two. The husks are turned into fiber, called coir, which is used in making cordage, brushes, and matting; the nut is turned into oil



The nuts are broken into small pieces and dried in the sun; the copra—as it is then called—is sent to the coconut-oil factory



For lack of train service, the coconuts travel down the river to the factory on rafts, after the fashion of logs



He is injecting germs from a diseased chicken into a well one, in order to test the germs' capacity for producing disease

He Doctors Sick Chickens

ANY hen, or Dr. B. F. Kaupp, a poultry pathologist, will tell you that chicken diseases, including the pip, are no joke. Moreover, Dr. Kaupp will tell you that they are most interesting. For instance, the correct dose of sulphate of strychnine for a hen is one fifth of a grain. It would kill a human being.

Dr. Kaupp is about the first scientist who has specialized in fowl troubles. He is connected with the North Carolina Experiment Station, where he has saved many a chicken's life—temporarily, at least.

Live Fowl by Parcels Post

THE cake-box that the postman is so carefully carrying in his hand contains, not cake, but two baby chicks. There is also in the box some straw and enough food to last the chicks till they reach their new owner, who is seventy miles away. They are traveling by parcels post.

It has been found that it is easier and cheaper to ship chickens after they have come out of their shells than it is to ship the eggs. In the first place, the eggs are all hatched in one incubator. The resulting chickens stand shipment much better than eggs. They do not need to be packed in excelsior, so they really weigh less than the eggs would do, and the cost of sending them is less. But what makes the plan really feasible is that newly hatched chicks do not need water for twenty-four hours. After that time they take up regular drinking habits, and might die of thirst if sent on a long journey.

The postman will see that the baby chicks arrive safely at their destination

How Bees Get Rid of Their Wax Scales

By Edward F. Bigelow

THE nectar that honeybees gather from flowers is changed within the bee's body into a secretion that is exuded on the surface of the wax-plates on the lower side of the worker's abdomen. These secreting surfaces, or wax-plates, may be seen by examining the under surface of a bee's abdomen with a low-power microscope.

The glands that secrete the wax are on the abdomen, immediately above and in contact with the wax-plates; and the exudation of the wax takes place through minute pores. As soon as this fluid wax comes in contact with the air it hardens and forms a coating on the outer surface of the plate. This is gradually thickened by the addition of wax from the pores.

Now, bees possess an ingenious, though not always effective, mechanical device for removing these scales, and the operation generally takes place while the bee stands on the comb. The hind legs are fitted with rows of sharp hairs, or spines, called pollen-combs. These spines are stabbed into the scale, sometimes catching the scale and sometimes not.

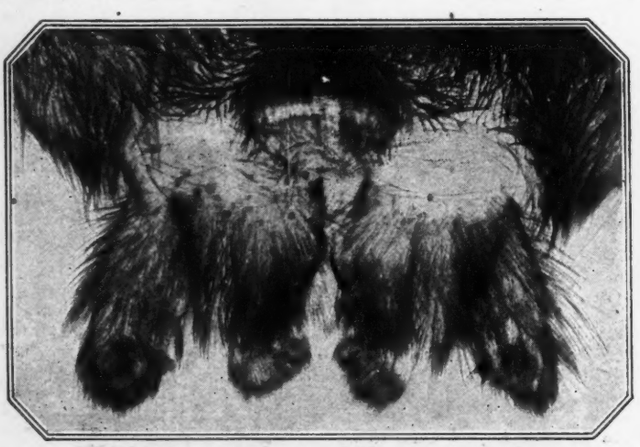
At wax-building time the bottom of the hive is sprinkled with scales, although it is asserted that these are sometimes gathered up and utilized.

The scales are then passed forward to the mandibles. The microscope shows that many of the scales on the bottom of the hive have been scratched by these spines or by the mandibles.

The device seems to work fairly well, but not ideally so. Sometimes the bee will take a scale from one side, and then from the other; sometimes two or three in succession from one side; frequently it will try to push off the scale, but unsuccessfully.

It will persist until the scale is impaled on the spines, or until it becomes discouraged and discontinues. When the spines do seize a scale, it is quickly transferred to the mouth.

Sometimes, when the scale reaches the mandibles, it is worked over by them alone; but at other times the fore legs are used to assist the mandibles. If the scale is thin the mandibles can handle it alone; but when it is thicker the bee calls on the legs for help. At first the masticated wax is rough and flaky, but later it is reworked gaining in smoothness.



The bee's hind legs are fitted with sharp hairs, or spines, called pollen-combs. The bee uses these spines in removing the wax that forms on the under side of its body; this wax hardens on contact with the air

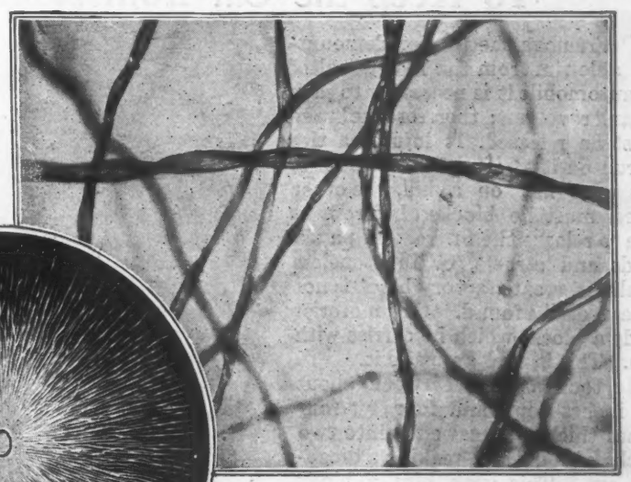
Spoiling the Hog's Sport

PIGS spend most of their lives trying to wear out their noses. They succeed in doing a good deal of damage to the pasture without injuring the protuberance. Naturally, the farmer objects to the destruction of carefully grown turf, and with a specially designed tool he puts little metal rings in the gristly upper rim of the pig's nose. A "rung" pig is comfortable as long as he confines his food hunt to the surface of the ground.

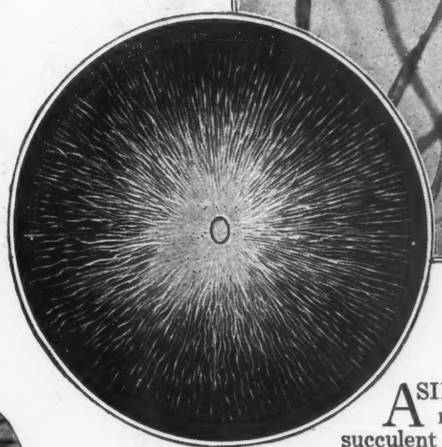
Ringing a pig of ordinary size is easy, but special arrangements must be made for handling the big ones. Sometimes they are caught and hog-tied; but if there are many to be held, a stanchion or stocks, such as the one shown in the illustration, is helpful. The frame is made of two by fours and two by sixes. The sides of the stanchion are hollowed out so as to fit the animal, whose neck is practically as wide as his head.

The pig must be restrained while his nose is being "ringed"; in this type of stanchion he is held in by his ears and his rolls of fat

Cousin to the Hollyhock



In drying, the round cotton fibers shrivel into spirally flattened forms; on this peculiarity depends the value of cotton for spinning



A single cotton seed cut in half, with the delicate fibers radiating from its centre

ASIDE from the botanists, probably not many people associate cotton with the succulent pods of okra from the kitchen-garden or with the tall hollyhock. In common with these, however, cotton belongs to the great mallow family, and is cousin to both okra and hollyhock. In the early part of the sixteenth century it even had its place in the Colonial flower-beds of Maryland; but it has been a long time since cotton appeared in the flower-bed.

Cotton, as it is now made, is composed of the fibers produced by this plant. These are single-celled hairs that grow upon the seeds of various cotton plants (*Gossippium*). In Sea Island or long-staple cotton these fibers reach a length of about two inches; but in upland or short-staple cotton, which is the main crop of this country, they are very much shorter.

Each capsule, or boll, is about an inch in diameter, resembles a squatty acorn, and contains many hairy seeds. These are packed tightly into a hard mass in the unripe boll, which on maturing splits lengthwise into from three to five sections. These pieces then open out, allowing the hard, compact mass to dry and expand into a loose, fluffy tuft. It is these tufts that are gathered and taken to cotton-gins, where the fibers are removed and pressed into bales.

Cotton is cellulose in its purest form, and is an important factor in the manufacture of smokeless powder. It is estimated that a bale of cotton was dissipated into gas at each discharge of some of the big guns used in the world war.

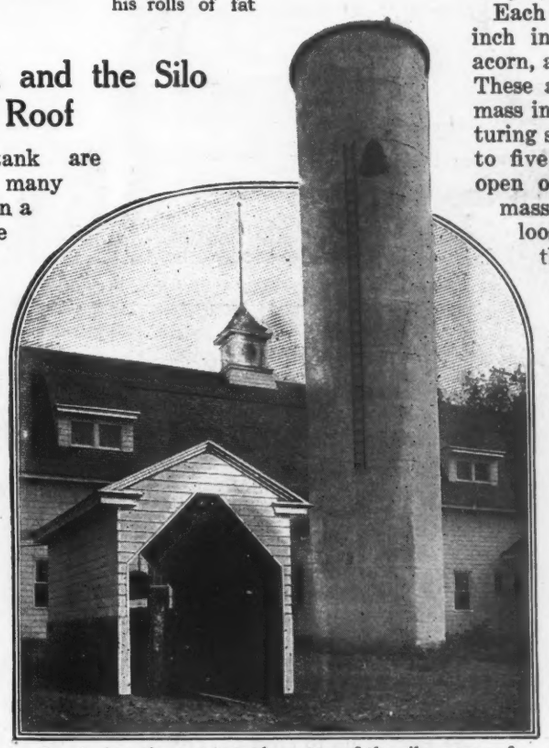
Strangely enough, the pictures you see of these very guns in action depend upon cotton; for, dissolved in alcohol and ether, cotton forms the basis of the collodion used by the photo-engraver in making the plate from which these pictures are printed.

Put the Water-Tank and the Silo Under One Roof

THE silo and the water-tank are Siamese twins now on many farms. By making the foundation a little heavier and by putting the tank up on top, one roof is made to do the work of two. The tank is put on a high tower with only a little added expense, and the pressure obtained makes it possible to throw a stream of water over any of the buildings on the farm. In the country, far from city fire departments to be called on for help at a moment's notice, this sort of protection is very important.

The pipe from the tank passes down through the silo, which is warm, except right at the wall, in the severest winter weather. This eliminates much of the danger of freezing.

The ladder is for convenience in placing the blower-pipe at silo-filling time.



In placing the water-tank on top of the silo, one roof does for both; also better water-pressure is obtained

To Keep the Car from Rolling When It's Jacked Up

TO remove the tire or demountable rim from the rear wheel of an automobile it is necessary to jack up and revolve it; therefore the brake must be released. It injures a tire to run on it while deflated, and if it has gone flat on a hill, the other wheel must be blocked before it is safe to release the brake. On paved roads and streets, or in stoneless localities, a satisfactory block is not always easily found. One motorist made a block, which he carries with him. This is how he made it.

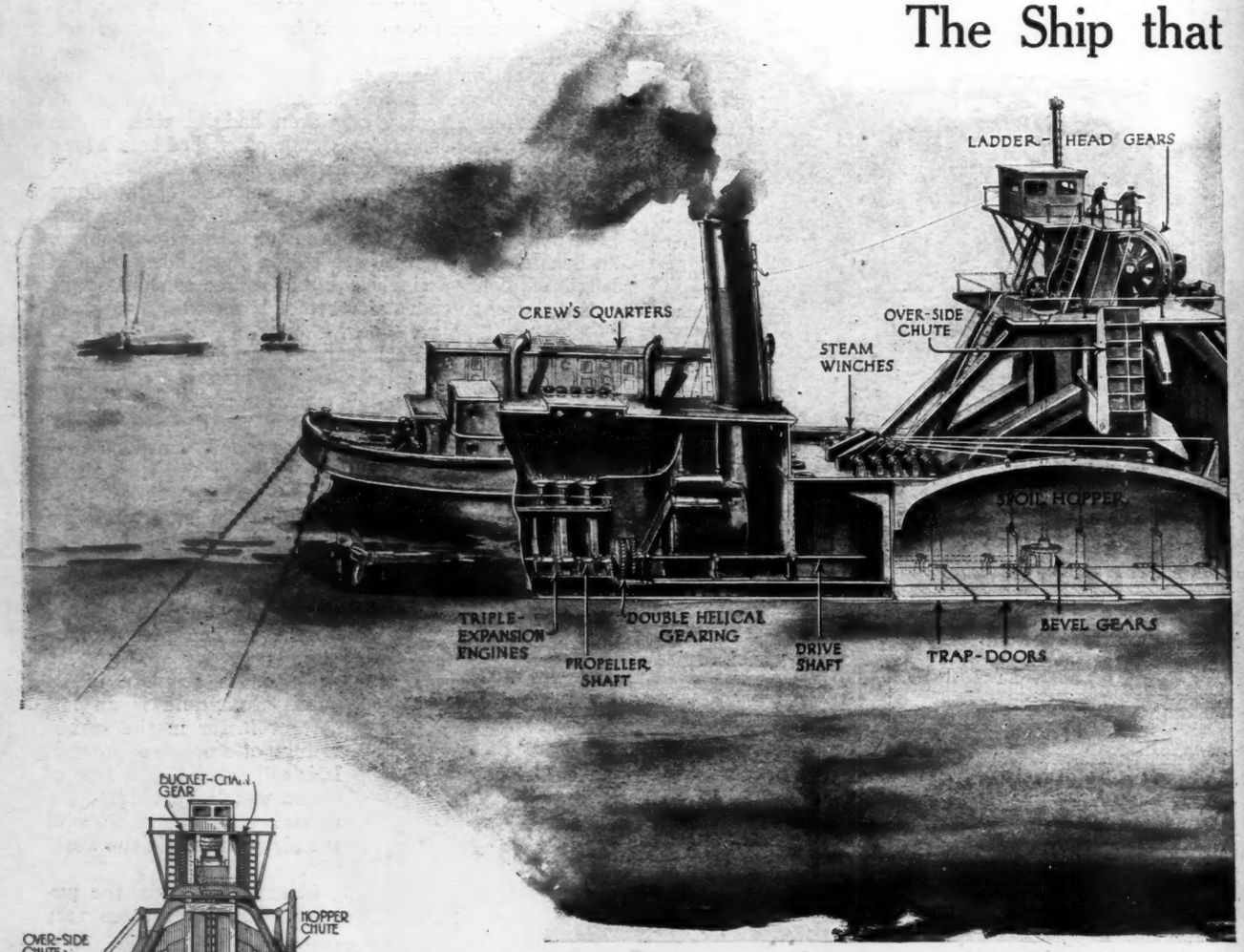
He took a piece of wood about ten inches long and four by four inches thick, and sawed it into two blocks of equal size, making a diagonal cut. This gave him a block wedge-shaped at one end—just the thing for blocking purposes and large enough to hold a heavy car on a steep hill. It is light, easily carried or stowed, and cannot injure the tire.

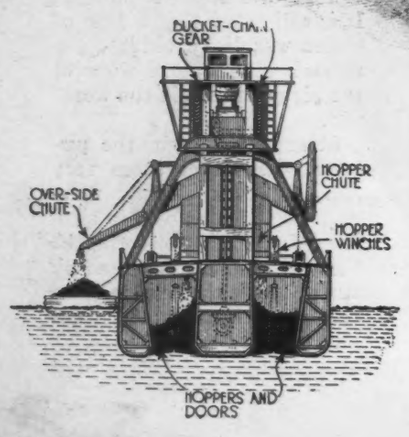
The wedge-shaped block under the left-hand wheel is a very useful article in emergencies. It is easily made by anybody with a little ingenuity, and may be easily carried in the car

A set of these blocks often comes in handy in the garage; for sometimes, when working around a car, both rear wheels must be jacked from the floor, and then it is necessary to block the front wheels to remove any danger of the car moving forward or back. In cases like this, these blocks are just what are required.

Safety demands that when a car is left standing alone on an incline for any length of time, its wheels should be blocked, to avoid accidental releasing of the brakes.

The Ship that





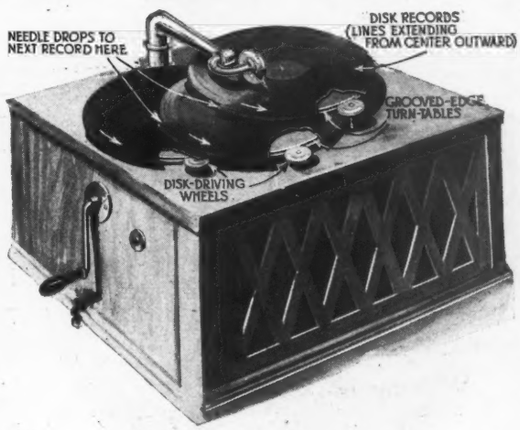
WHEN the engines of this Canadian dredger have served their purpose of propelling the craft to a channel that is to be deepened, they are coupled up to drive the dredging buckets. You will note that a shaft runs centrally through the hull of the vessel, and that at its forward end it has a bevel gear by which the drive is transmitted to the ladder-head gears. Near the engines are change gears, the purpose of which is to provide two ladder speeds.

Two sets of buckets are supplied. One set, of fifty-four cubic feet capacity, dredges soft material; the other, of thirty cubic feet capacity, is used on stiffer ground.

Why You Can Play a Whole Opera on This Phonograph

WHEN a disk record of a band is made for the phonograph, the vibrations produced by the sound waves emanating from the various instruments are engraved on the recording disk simultaneously by one and the same needle. Since each instrument has its own peculiar tonal quality and produces tones of a highly complicated character, accompanied by over- and under-tones that cover and blur one another, the record loses the finer shadings of tone and color and some of the characteristic individualities of the various instruments.

Samuel D. Mott, an inventor of Passaic, N. J., seeks to overcome this defect by a modification of the recording and reproducing apparatus. An individual record is made of each instrument or a group of instruments.


NEEDLE DROPS TO NEXT RECORD HERE
DISK RECORDS (LINES EXTENDING FROM CENTER OUTWARD)
GROOVED-EDGE TURN-TABLES
DISK-DRIVING WHEELS

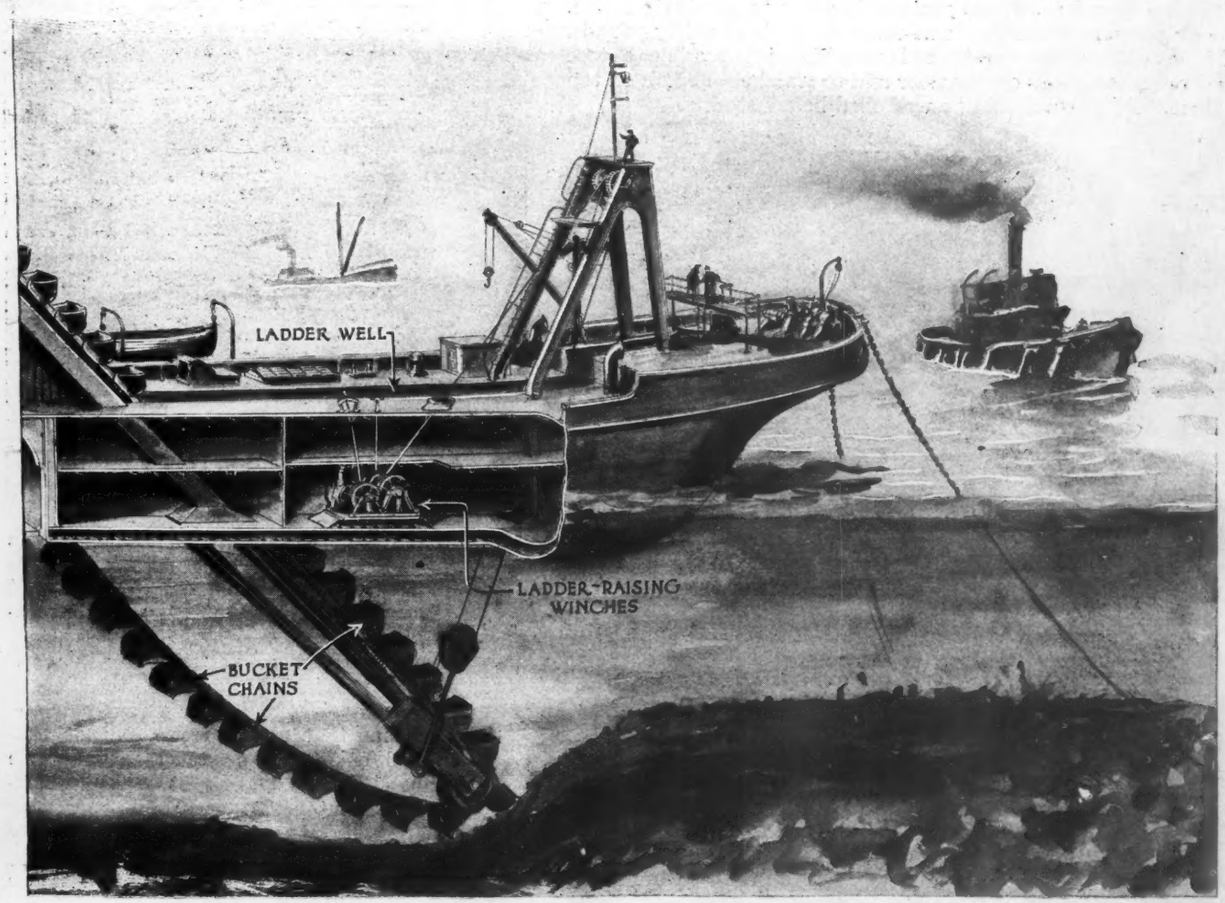
An invention designed to overcome the blurring of tones that usually occurs in recording a brass band for phonograph reproduction. Records of each instrument or group of instruments are made first and afterward synchronized

These records are carefully synchronized, and are then reproduced simultaneously on one or several phonographs. To this end the disk record of each instrument or group of instruments is provided with its own individual sound-box and stylus transmitting the sounds to a common horn.

By a series of gears or an endless belt or chain, the power of a small motor is transmitted to the turntables bearing the disk records by means of a friction drive. These disks are placed so that one overlaps the other.

The same inventor has also provided a means of reproducing without interruption musical or other records requiring two or more disks.

Digs Its Way Deep Down Under the Sea



The craft is called a "hopper" dredge, because the material excavated or dug up—the "spoil"—is lifted to the ladder-head and dropped down through a hopper into the hold, or else, by means of chutes, into barges on either side. From what depths can material be excavated? When the ladder is inclined at forty-five degrees, depths of fifty-seven feet can be dredged. When the craft is ready to move on, the ladder is raised by a steel-wire rope attached to an independent engine forward.

At the bow and stern are maneuvering winches driven by independent engines. By their means the mooring-chains can be worked either independently or simultaneously. The hopper doors are also independently driven by steam winches

How the Army Saved Space in Storing Automobiles

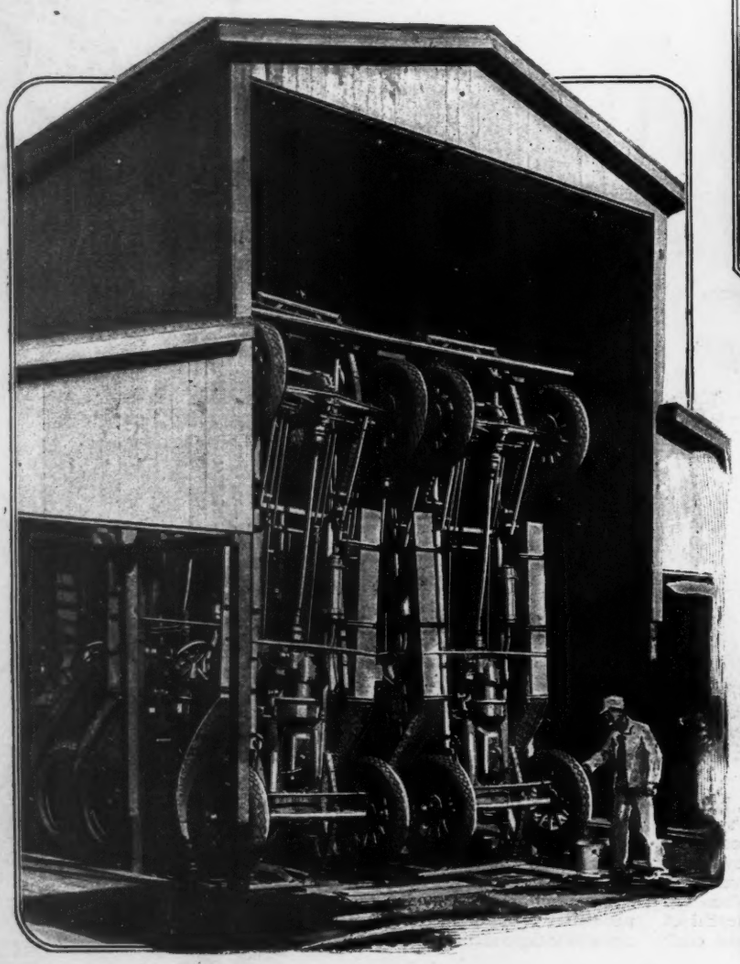
ANY one who has been compelled to find storage space for his automobile in the congested district of a big city will sympathize with the officers in charge of the storage program of the army when they were called upon to store thousands of cars and trucks.

It is a costly proposition to build warehouses covering acres of land to store vehicles that take up a great deal of floor space but leave many thousands of cubic feet between the vehicle and the ceiling.

A system of storing automobiles was devised, whereby the car rests on end. This is accomplished either by standing the machine on its front wheels, springs, and axle, the rear wheels being braced only enough to keep the car plumb, or by literally hanging the car to the ceiling. In this way thousands of feet of floor space was saved.

In order to store the cars properly it was necessary to drain all oil from the engine, remove the gasoline, and treat the inside of the engine with a heavy oil. The car should be stored absolutely vertical in order to eliminate strain. The air-pressure in the tires was reduced to about thirty pounds.

If the ceiling of the warehouse is very high, it is possible to store cased or crated goods on the floor and to stand the chassis on top of these. All parts should be well oiled before storing.



This is how the army stored trucks and automobiles. Valuable space was utilized, which saved the building of gigantic warehouses

The magneto is the heart of an engine. Here's how magnetos are tested at the factory on a production basis

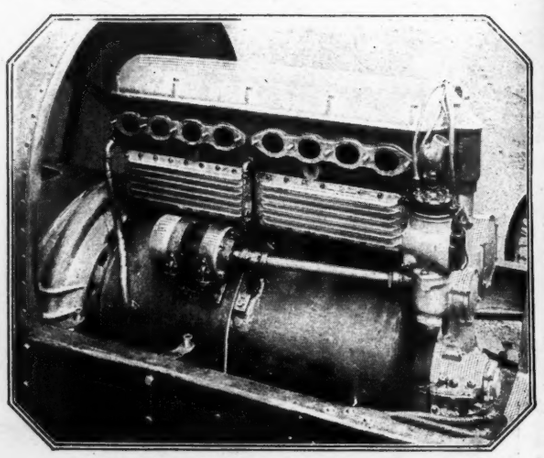
What's Wrong with the Magneto? Test It Scientifically

IT has been said that the magneto is the heart of the automobile, since without the proper spark, generated at exactly the right instant, the engine is of no avail. It is important, therefore, that the magneto must be correctly adjusted before it is installed in a car.

In the testing apparatus here shown, the magneto is first of all mounted on a small test stand, with the rotor shaft connected rigidly at the rear end to a large metal disk. Around the circumference of the disk are marks indicating the proper breaking points for different types of magnetos. The fact that the marks on the disk are several inches away from the center of the magneto rotor shaft serves to magnify the slightest error in the time and position of the sparking period.

At the same time, the duration of the spark is tested by a buzzer bell.

Eight Cylinders in a Row

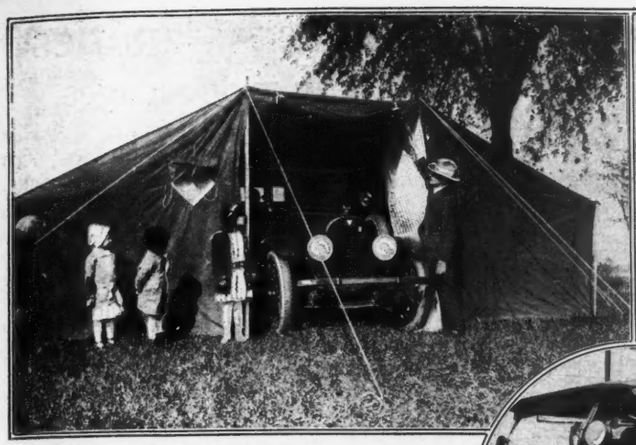


This eight-cylindered engine has hung up one world's record, and will shortly go after others

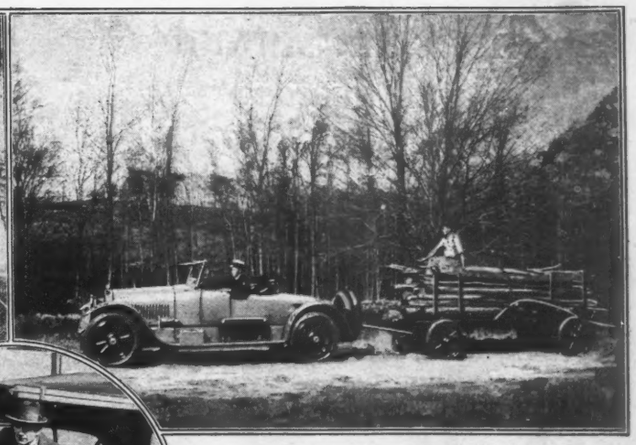
THE engine shown above is attracting a good deal of attention throughout the United States, for it made the world's record for ten miles in five minutes twenty and one tenth seconds.

The cylinders are set vertically and in a row. In spite of this fact, however, the total length of the engine is one and one fourth inches shorter than that of the small Buick "Six." With 296 cubic inches capacity the engine develops 150 horsepower at 3400 revolutions per minute. Its weight is about 475 pounds, or a trifle more than three pounds per horsepower. As you will note, this engine, therefore, closely follows the aviation engine standards.

The valve action is of the overhead type and is operated by a single cam-shaft on top of the engine. Heretofore all eight-cylindered engines have been made in the V-block type.



A tent that folds into a small bundle on the running-board and expands into a seven-room house when set up



Off goes the runabout, with its load of logs. Better be sure your car is a heavy one before you try it, though

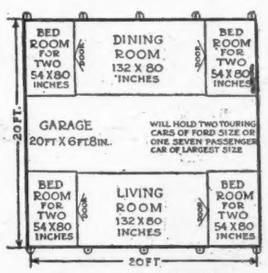
Camping by Automobile

MADE out of balloon silk is this complete fold-up house with four bedrooms, a dining-room, a living-room, and a garage large enough for two Fords or one larger car, all under one roof.

As shown in the plan view, the garage is in the center, flanked on one side by two bedrooms and the dining-room and on the other by the other two bedrooms and the living-room. One or both cars may be taken out for errand duty without disturbing any other part of the tent except to open up the tent flap.

The tent is twenty feet square, and the bedrooms are large enough to accommodate a regulation folding cot. The entire tent may be folded up into a small bundle and conveniently carried on the running-board of the car.

FLOOR PLAN


BED ROOM FOR TWO 54 X 80 INCHES
DINING ROOM 132 X 80 INCHES
BED ROOM FOR TWO 54 X 80 INCHES
20 FT.
GARAGE 20FT X 6FT 8IN.
WILL HOLD TWO TOURING CARS OF FORD SIZE OR ONE SEVEN PASSENGER CAR OF LARGEST SIZE
BED ROOM FOR TWO 54 X 80 INCHES
LIVING ROOM 132 X 80 INCHES
BED ROOM FOR TWO 54 X 80 INCHES
20 FT.

Plenty of room for every one, including a garage for the car

The Runabout Truck

"BUT you promised to deliver that load of logs today," came the voice over the wire, "and I must have them or lay off my entire gang of carpenters."

"It simply can't be done," replied the owner. "All my horses are away, and—But wait; I have an idea. I'll get those logs there as per schedule. Good-by."

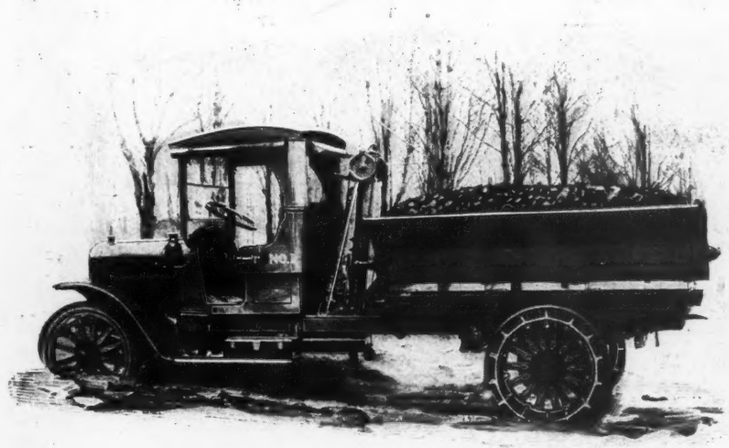
Going out into the yard, he surveyed his expensive new runabout, all spick and span. Heaving a heavy sigh, he coupled it in front of the big wagon filled with logs, and let in the clutch. The runabout took up the load and ambled easily toward her destination. While we don't advise making a practice of this, it might be remembered in an emergency.

The rim comes in two styles, one for shaft, the other for chain-driven trucks

Another Traction Rim for the Motor-Truck

IN many of the rural sections of the United States, motor-trucks often have to be kept in their garages, even when there is plenty of work to be done, on account of the poor condition of the roads. While many devices have been invented to overcome this great economic waste, most of them have been complicated. But a new traction rim has just been invented that can be attached to any standard-size motor-truck wheel without making any changes in the wheels or the chassis. The new rim may be attached to either the inside or the outside of the wheel, or both.

Furthermore, the rims may be applied and remain permanently in place, since they are of smaller diameter than the rubber tires regularly fitted on the wheels and do not come into contact with the road surface until the truck strikes a soft spot. Then the rims, which are provided with crosswise lugs or cleats forming an integral part of the rim bands, come into action and pull the truck through the soft earth. The outside diameter of the rim is generally about four inches smaller than the outside diameter of the rubber tire when worn down to the point where it is ready to be taken off, so that there is always a clearance of over two inches between the rim surface and the hard-surfaced road.

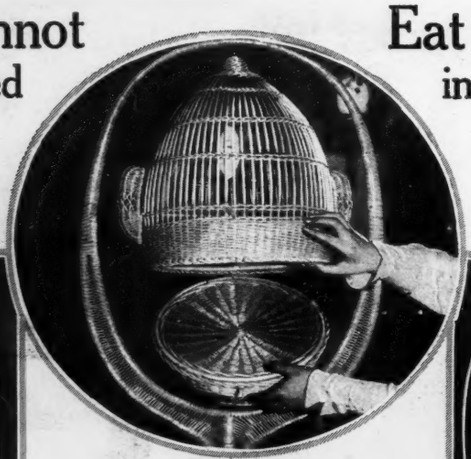


A new type of traction rim which attaches on both sides of the truck wheel rim. It is designed primarily for bad roads and places where the ordinary truck wheel cannot obtain traction

The Cat Cannot Eat These Canaries

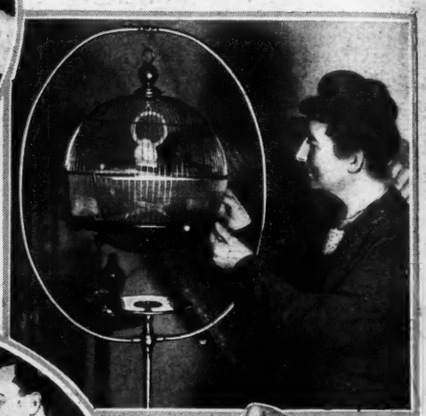
So well guarded in their gilded cages

From the over-curved branches of the artificial tree-stand below hang an Italian cage and a reed lantern cage

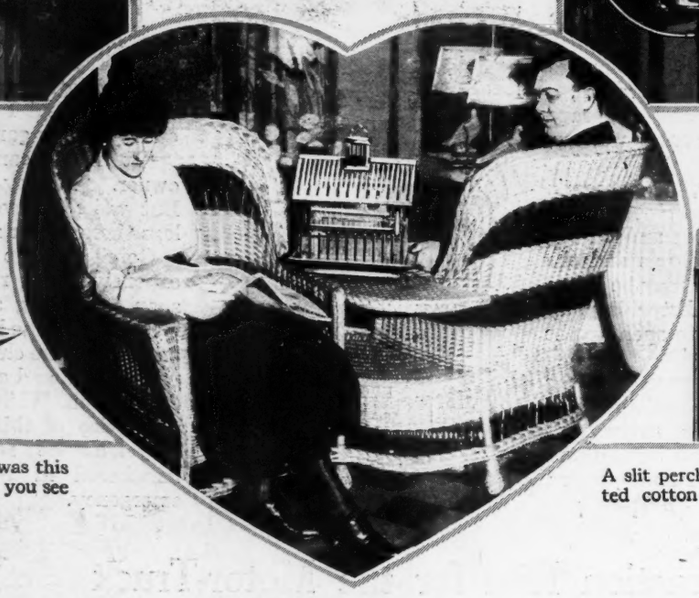


Egg-shaped, the reed cage above cracks open like a cooked egg when the cage is to be cleaned

"Swing me high, swing me low," sings the bird, after the popular song; its cage may be adjusted up and down



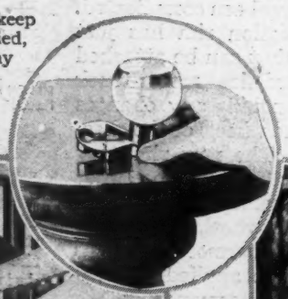
"Room and bath, please," was this bird's order. He got it, as you see



A bungalow within a bungalow—for the bird; the little fence around it keeps the seeds from flying out

A slit perch filled with medicated cotton destroys the mites

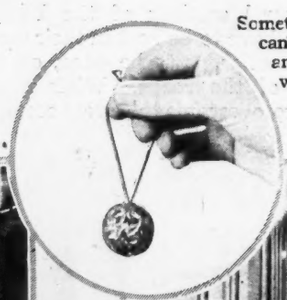
Enough water to keep your bird supplied, should you go away for several days

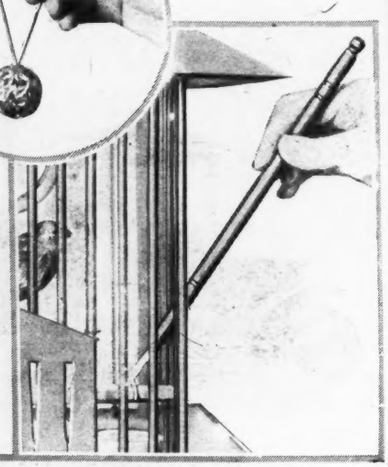


He loves his dinner-bell; it tinkles when he pecks at it

A heavy metal cage on a metal stand—all for one small bird

Something for your pet canary to play with and also to peck at when so inclined





The perch-puller for cleaning purposes; it looks like a tooth-puller

Here Comes the Cake

Bride, bridegroom, horseshoe, and flowers, all assembled in readiness for the fatal moment

Sixteen brides, eighteen bridegrooms! Two will be left waiting at the cake! Each little figure is molded in halves —front and back; then the two halves are stuck together

Pairing them off. Note the rejected bridegrooms, overcome with grief, swooning on the ground

They are wed under a good-luck horseshoe. "They need it," say the cynical. The horseshoes are made of sugar, starch, and gum

Tying the leaves so they won't fall down —that would spoil the sugary wedding

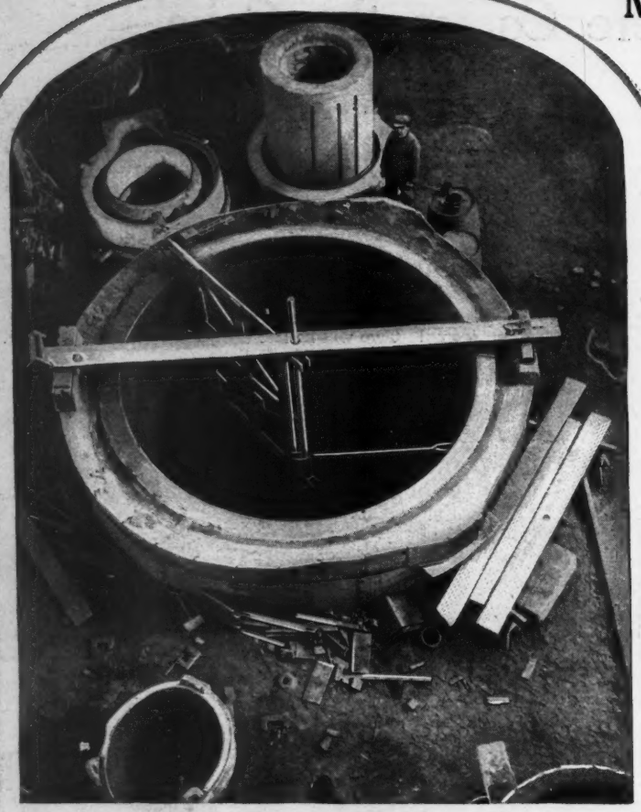
Not bandaging— bridal veils. To each bride is assigned three inches of net, and this is glued to her paste head

To each pair is given a dove; it hovers over their heads for a good omen as they stand on top of the cake

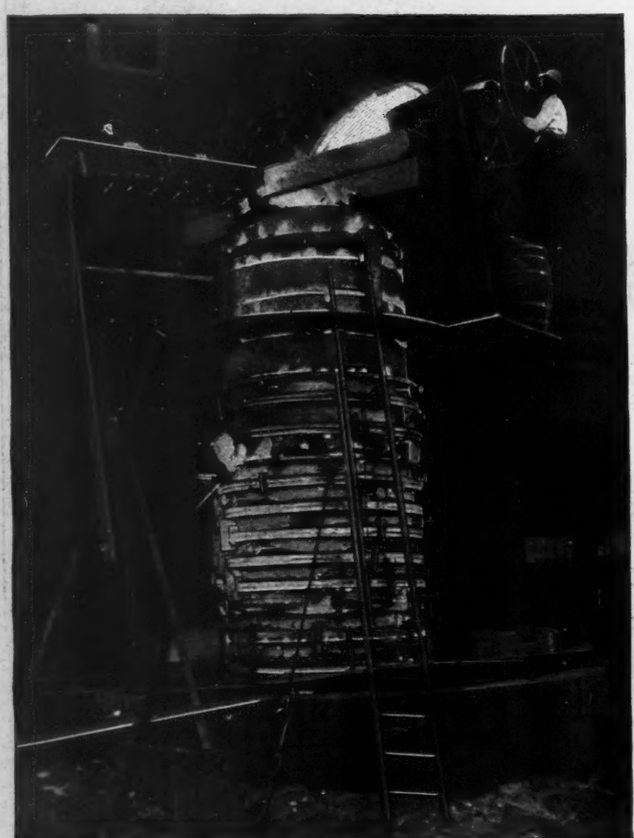
Just before the wedding supper: they are almost ready to stand on the slippery icing

Making Gigantic Hollow Castings

Manufacturers demand big equipment



The gatelike structure in the center of this partly completed tank casting is used in shaping the walls of the mold



The flames are caused by the burning of gases driven out of the clay by the terrific heat of the molten iron

WITH the unprecedented growth of industrial chemistry in the United States has come a steadily increasing demand for larger and larger equipment. Chemical manufacture on a large scale requires, among other things, cast-iron tanks, kettles, and bowls of enormous size, the casting of which is a task of considerable difficulty even for modernly equipped iron foundries.

One of the accompanying pictures shows the partly completed outer mold for the casting of a tank nine feet deep and fourteen feet four inches in diameter. The gatelike wooden structure attached to the center pin is the sweep, which is used for shaping the cylindrical walls of the mold.

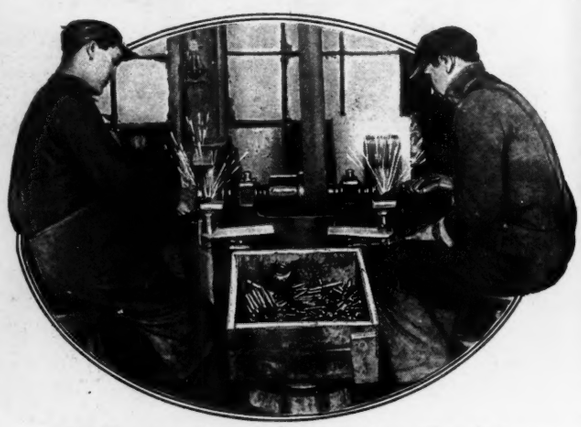
The ground around the mold is filled in with cinders and is well ventilated with pipes. The walls of the finished mold are torch-baked, and are finished off as carefully and smoothly as the surfaces of the core, or inner mold. After the core has been properly centered and weighted, the mold is ready for the metal. The channel for the inflow is connected with the base of the mold, and in this way a minimum amount of abrasion of the earth walls is assured.

The other picture shows the pouring of the molten iron from a thirty-five-ton ladle into the unusually high riser of the big mold, only the top of which is above the ground. The small flames shooting from the joints of the riser are caused by the burning of the gases driven out of the clay by the terrific heat of the molten iron. The ladle with the iron had to be lifted by a crane and the man at the wheel in the illustration is regulating the flow of the metal.

Testing Steel by the Spark It Gives Off

FOR many years most of the left-over pieces of high-speed steel tools, cutters, and other implements have been thrown away, yet this metal is very expensive because it contains tungsten.

Within the last three years a method has been devised by which most of this valuable scrap is recovered. In this process each piece of scrap is applied to a grinding wheel of special composition, whereby certain kinds of sparks, depending on the composition of the metal, are given off.



Testing scrap steel. The sparks given off against a wheel tell which are high tungsten and which low

Tracing Earthquake Records by Rays of Light

A new recorder of earth tremors, which eliminates friction, has been invented at Kilauea Observatory

By L. W. de Vis-Norton, *of the Kilauea Volcano Observatory*

BY the construction of an instrument that has succeeded in eliminating the element of friction, a very distinct advance in the recording of earth tremors must be credited to Dr. T. A. Jaggar, volcanologist in charge of the Kilauea Volcano Observatory in Hawaii, and to his assistant, Dr. Arnold Romberg.

By doing away with the usual method of employing a stylus to trace a line upon a revolving drum covered with smoked paper, and by employing a system of photographic registration, some very remarkable results have already been attained, though the instrument is still susceptible of considerable improvement.

Record Made by Light Ray

The principle of the new idea in recording is that of an accurate record, made with a ray of light from a tiny straight-filament electric bulb. It was necessary to work with material at hand in the observatory, and one of the four regular seismographs in use was therefore dismantled and reconstructed on the spot.

The lamp was set up at a distance of 150 centimeters from the end of, and in line with, though slightly above, the arm of an Omori 100 - kilogram horizontal pendulum, the tip of the arm being fitted with a magnetized horizontal needle. An ordinary light mirror, with a diameter of twelve millimeters, was then firmly fastened to a vertical taut silk fiber, held on a post standing on a concrete table; while a second magnet was attached to the back of the mirror in such a manner that it lay at right angles, with its north pole adjacent to the south pole of the arm magnet.

Projected in Ordinary Camera Lens

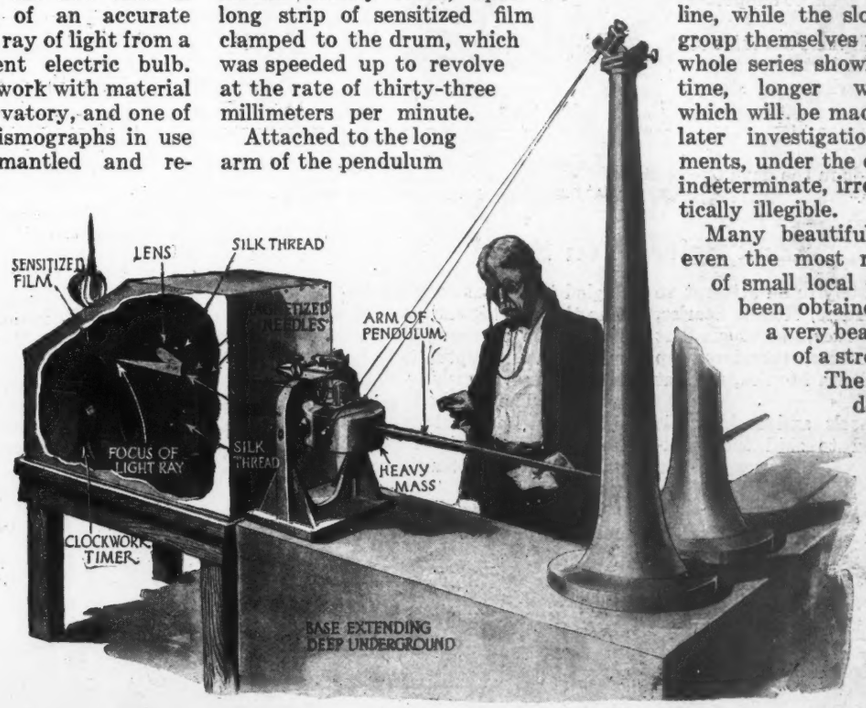
In this position it will be seen that horizontal earth displacement would move the pendulum and the mirror supports, while the frictionless magnets rotated the mirror around a vertical axis in response to inertia of the mass.

The light ray was projected with an ordinary camera lens, of about thirty meters infinity focus, upon a long strip of sensitized film clamped to the drum, which was speeded up to revolve at the rate of thirty-three millimeters per minute.

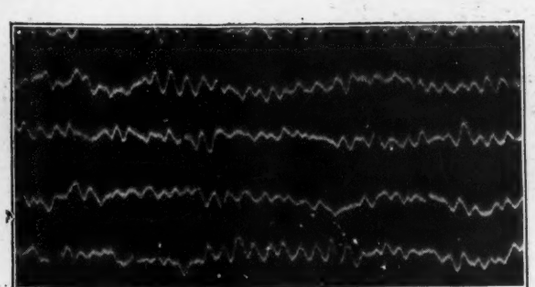
Attached to the long arm of the pendulum was an openwork metal box suspended in a vessel filled with oil, whose effect is to strongly damp out mechanical vibrations, but which leaves the mirror extremely sensitive to earth movement, while a clockwork timing arrangement shuts off the light once each minute, with a longer period at the end of each hour, thus making a perfect timing record upon the photographic paper.

While, owing to imperfections in the available mirrors, the optical work is as yet in its earlier and crude stages, the magnification and openness of the records obtained are truly remarkable, and a vast improvement over the old stylus method of registration. While the records are, in some respects, similar to those of the Galitzin instruments, the finest microtremors are shown in a continuous wavy line, while the slower microseisms group themselves rhythmically, the whole series showing, for the first time, longer wave-movements, which will be made the subject of later investigation, these movements, under the old method, being indeterminate, irregular, and practically illegible.

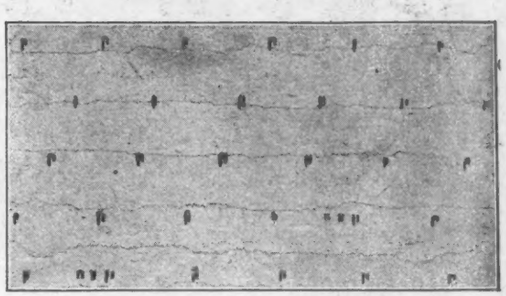
Many beautiful photographs of even the most rapid movements of small local earthquakes have been obtained, together with a very beautiful seismogram of a strong, distant shock. The difficulties of damping, friction, magnification, opening the record, and time-marking have already been overcome, and the resulting seismograms are clear, transparent negatives.



In this instrument devised by Dr. A. T. Jaggar and Dr. Arnold Romberg, of the Kilauea Observatory in Hawaii, earth tremors are recorded by a system of photographic registration; remarkably accurate records have been made, although the machine is still susceptible of improvement



A record by the old method, made by a writing-pen on a drum covered with smoked paper. The perpendicular marks show intervals of one minute. The magnification is small, the phases of tremors indistinct



In the new method by photography the time marks are indicated by small breaks in a continuous line. A study of this record of a normal period of usual earth tremor is of great interest

A Tire as Tall as You

IF a thirty-one by four inch tire costs thirty dollars, what will one of the monsters above cost? And what manner of car will they be used on? Such are the questions that rise in your mind when you look at them. They are nearly as tall as the men who handle them.

Later on they will be attached to a Handley-Page airplane, and then they will seem almost too small to support the giant airplane.

The strides that airplane manufacture has taken in the last ten years are readily realized when you stop to compare the Handley-Page machine of today with the little "Demoiselle" plane that hovered over the first aviation fields in the days of Moisant and Hoxey.

A Swan for a Hood

UNDER the calm exterior of this graceful swan lie cylinders, spark plugs, oil, grease, a motor, and all the other things that the hood of an automobile usually covers. The swan is playing hood for a wealthy man living in India, whose ideas of motor beauty are most peculiar. On the front axle are a pair of gargoyles, placed there to emphasize the swan's grace.

Out of the mouth of the swan comes a warning hiss instead of a blast from a horn.

The Smallest Post-Office

ALTHOUGH only five by five by seven feet in dimensions, outside measurement, you will find a postmistress stationed on the inside of the post-office shown in the picture to the left, for the transaction of any kind of post-official business negotiated at any of the larger branch offices at the national capital.

The diminutive office is situated at the corner of F and 9th streets, Northwest, Washington, D. C. The business of selling stamps and mailing letters is here carried on in a most efficient fashion.

Look Before You Speed

DRIVING desperately in an attempt to overtake the leaders, Roscoe Searles, in an automobile race, although not familiar with the course, thundered up "Death Curve" at Santa Monica, Cal., at a high rate of speed.

Cramping his wheels and locking his brakes, Searles tried to skid the right-angled turn; but so great was its momentum that the big car swerved only slightly, leaped the sand-bag barricade, narrowly missing a eucalyptus tree, and crashed to the ground, crushing one of the rear wheels. The crushed wheel acted as a drag, and finally stopped the car with its hood a few feet from the steps of a bungalow. Neither Searles nor his mechanic was injured.

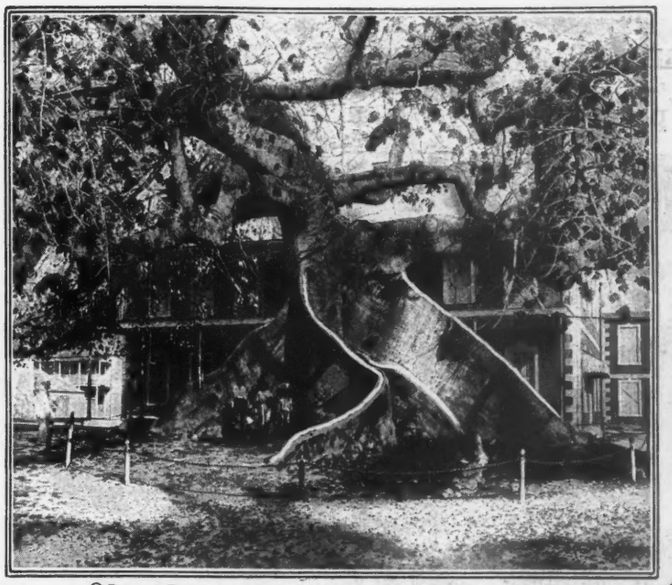
And the photograph caught him in the act!

The Top that Winds Itself Up

HERE is a top that winds itself and spins on both ends. It works on the same principle as the see-saw.

The peg top is surrounded with a metal knob. One end of the string is attached to the stem.

By holding the metal knob between the fingers, and pulling the string out two thirds of its length and then letting it hang loose, the string rewinds. After doing this a few times the speed will be so great that the top will spin on either end.



© Brown & Dawson

Rex! What Time Is It?

THE dog will have his watch, says the lady below; but we don't see what use it will be to him unless he learns the whys and wherefores of time.

The watch is not intended for use, but for beauty, scornfully says the same lady. In fact, the watch is not a real one. We give children toy watches, so why not give them to dogs?

As to the dog's delight over his new possession we know nothing; but, since he is a full-blooded Boston bull terrier, we fear he may not be overjoyed.

It's the Silk-Cotton Tree

WHAT is your mattress made of? If it is not made of expensive hair or cheap straw, it may easily be in the in-between class known as the silk-cotton fiber mattress. Silk-cotton fiber grows on the curious tree shown in the picture above. It is contained in the fruits that hang from the branches.

Though silk-cotton is usually used as stuffing for mattresses and cushions, it is sometimes woven into a loose, coarse cloth. The fiber is short and silky in appearance. The trees grow in the tropics.

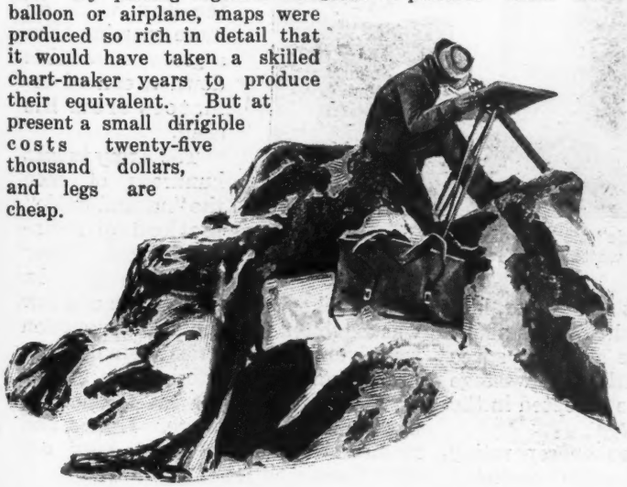
©Press Illustrating Service

He Must Anchor Himself to the Mountain

RECENTLY topographical surveying in Alaska has been done with the help of the panoramic camera; but under the conditions usually found among high mountains it is probable that the topographer will long have to do his sketching in the old-fashioned way, by hand, and in doing so must often face such difficulties as the topographer in the picture below is up against.

This surveyor is working on a peak in the Yellowstone country, 10,500 feet above sea-level. He is also above the clouds. The wind at this height is so strong that he has had to tie and weight down his working table. As an extra precaution he has even been forced to lash one leg to a projecting spur of rock, to keep himself from being blown away from his job.

The day is not far off when map-makers will sail comfortably to their work in a dirigible and photograph the wilds at their ease. Photographic map-making was done successfully during the war. By piecing together hundreds of pictures taken from balloon or airplane, maps were produced so rich in detail that it would have taken a skilled chart-maker years to produce their equivalent. But at present a small dirigible costs twenty-five thousand dollars, and legs are cheap.



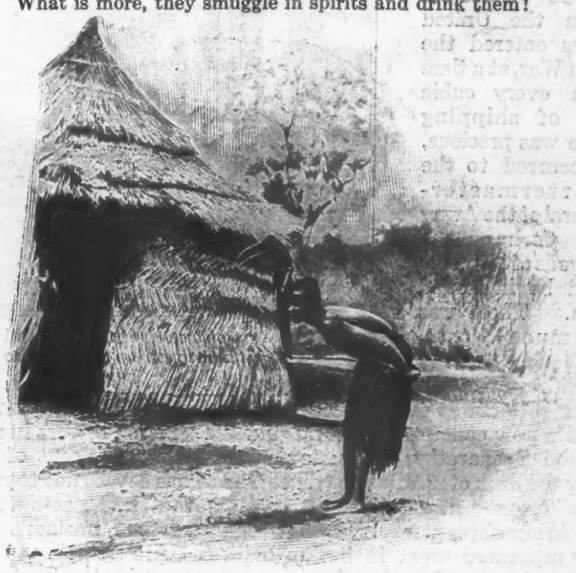
Some Bird! It's a Native of Africa

IT was a case of "look like a birdie" and not "look at the birdie" when this picture was taken.

Perhaps you wouldn't be fooled by the straw skirt and the artificial bird's head, but the Munshi who is wearing these strange garments isn't interested in you; he is trying to fool a bird that he wishes to catch; and, according to his previous experiences, he will do so.

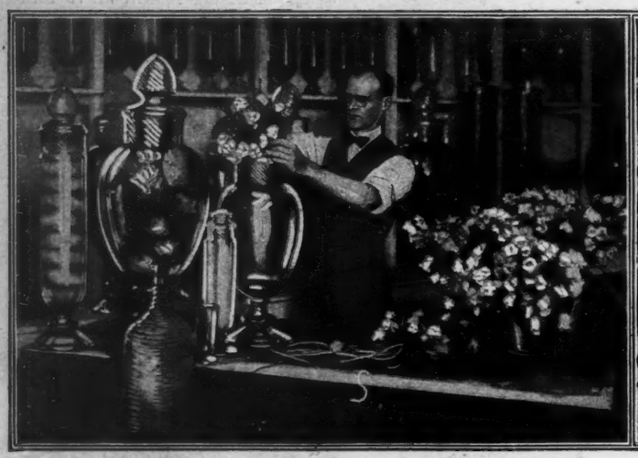
The Munshis are a negro race living in Bassa, which is a province in the British protectorate of northern Nigeria. They are an industrious race, and are great agriculturists; but they are very quarrelsome and are said to be always looking for trouble.

What is more, they smuggle in spirits and drink them!



Mummifying Fruits, Flowers, and Vegetables

It is done by "processors," of whom there are only fifteen in the world



Each kind of flower demands a special chemical solution of its own. The right one will preserve it for many years

The peaches in these jars are, alas! not good to eat, for they are preserved in poison. But they will last for many years

IN a basement room in Los Angeles a magician is at work. He is putting fruits and vegetables into tall, glass-stoppered jars, to keep for years to come, and canning lilies and roses and bridal bouquets. His tables are loaded with the finest of everything that California can raise, and his shelves, lined with huge containers, will soon hold a complete assortment of the state's products.

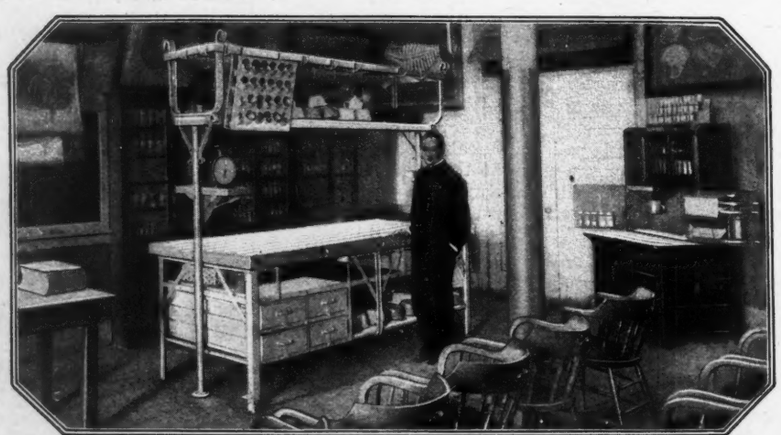
For eleven years W. H. Fowler has been in this delicate business, all the while experimenting as well as preserving. It is said that in the whole world there are only fifteen "processors," and that this man has discovered chemical secrets that the other fourteen would give much to know.

To outsiders the "processing" is a mystery. We are told that no heat and not a drop of alcohol is used in the wonderful displays we have seen at various fairs and state-boosting exhibits; that the jars are not air-tight; that the preservatives are rank poison; and that the treatment of different products varies according to their kind and nature. Each color in the flower world requires a different chemical, blue being the hardest to preserve; and, stranger still, flowers of one kind and color—red roses, for instance—do not respond to the same treatment. It is as if each variety had absorbed different elements from sun and soil.

Fruits, vegetables, and flowers that are porous are "easy," Mr. Fowler says; but the solid ones require long, patient labor. Apples take from six months to a year, and during that time must be dosed frequently. An exact record of each jar must be kept; the accidental destroying of a bluebell record meant the loss of a valuable secret.

Sending the Butcher to School

MEAT, from time immemorial, has been cut up primarily to please the eye. When the United States entered the Great War, at a time when every cubic inch of shipping space was precious, it occurred to the Quartermaster-General of the Army that perhaps the methods of butchers could be improved upon. There was too much waste, and bone.



The Army discovered the "natural guide" methods of cutting up meat. It is up to the packers whether the old wasteful methods can come back

The result of the investigation was the development of what is now called the "natural guide" method of separating or tearing meat along the lines of natural cleavage. The bone is removed, and most of the fat. The Army abroad received this naturally separated meat in burlap bags. Steaks, chops, and tenderloins were put in one bag, stew meat in another, kidneys and livers in a third. Thus about thirty per cent of the shipping space was saved, not to mention the wastage that had come to be accepted in the packing business.

Are we going to keep on separating meat by the "natural guide" method? Or are we going to adhere to the old wasteful methods? It remains for the packers to decide.

A butcher ought to be able to take a two-pound tenderloin steak from the ice-box with no more exertion than a grocer now takes down a can of tomatoes from his shelf.

The Army taught hundreds of men the "natural guide" method of separating meat. They were taught in special schools. The skeleton of a cow was exhibited to them and instruction was given by an experienced man in the proper way of quartering the animal and then tearing the meat along its natural lines of cleavage. Hotels and restaurants, and butchers, why not offer these men jobs?

When the Burglar Goes a-Burgling

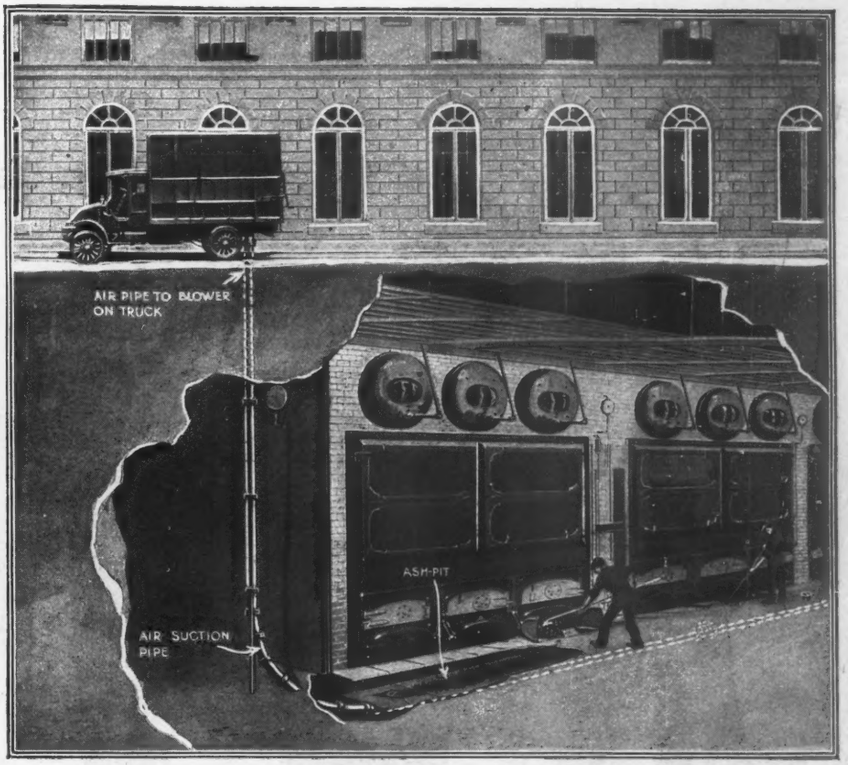
"HANDS up!" says the hold-up man. "Now give me the money I see in that drawer," he continues.

The bank cashier grabs it gleefully; for as he takes it out two contacts above and below it come together and close an electric circuit that opens a trap-door on which the burglar is innocently standing.

Forthwith the burglar lands in the trap below, and is later fished up by a policeman. "Fished up" is no idle jest; for the cashier has at his right hand a wheel which, when turned, will open a valve in the compartment below and flood it with water.

Of course, in using a device like this there is always the danger that the cashier might accidentally pull out those bills when the bank's best customer stands before him.

As the cashier pulls out the money two contacts touch each other and close a circuit, opening a trap-door



You rake the ashes into a pit, and that is the last you see of them; a truck with a blower on board will come and draw them away by means of a pipe line

The Pipe-Line Ashes Express

THINK of the cost in labor, ash-cans, and conveyors in getting ashes to the ash-dump; and think of the inconvenience that ashes cause. But these troubles are no longer necessary, for a pneumatic conveying system has been devised by means of which you need only rake your ashes from the furnace into a pit in front of it. That is the last you see of them; in a few days they will disappear.

On the level of the floor of the pit there is a pipe line having several holes in the top through which the ashes will drop. This pipe line continues on and upward to the street level. At regular intervals a large ash-removing truck will stop at this pipe. Pipe and truck are connected. A blower on board is attached to the truck motor, and soon the ashes fly upward and land in a bin in the truck. As the ashes in the pipe are sucked up, those in the pit fall through into the pipe, and gradually the pit is emptied. Off goes the truck with your ashes. Simple? Both simple and cheap; for the cost of this service is about one third that of ordinary ash-removing.

When the truck leaves your building, it draws up alongside of another and much larger truck stationed near by. The ashes are dumped from one truck to the other. Thus the smaller truck containing the blower is able to proceed to another job. When the large truck is full, it sets out for the main ash-dump.

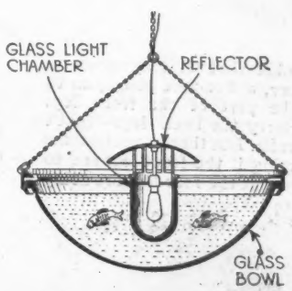
Electric Lights for Goldfish

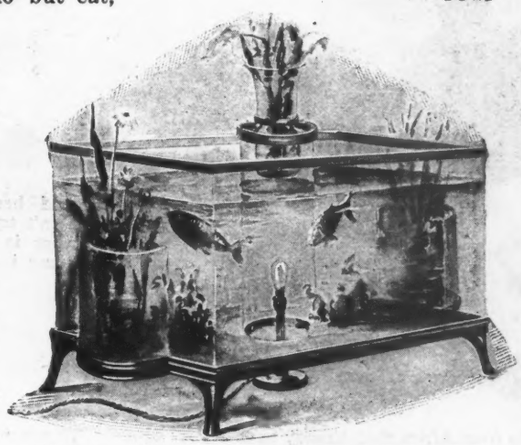
HOW would you like to be a goldfish? Fine, you say; nothing to do but eat, sleep, and swim in comfort. But don't be too sure. Rudolf Eickemeyer, of Yonkers, has just invented a new ornamental aquarium, which has an electric light in the center surrounded by a transparent cylinder of many colors.

The light is turned on, the cylinder revolves, and the goldfish goes through all the colors of the spectrum. He may be sleeping peacefully when his owner suddenly decided to show him off.

Another design calls for an aquarium shaped like an inverted electric light globe, to be hung in the window. The sunshine, the gold of the fish, and the green of the plants form beautiful color effects.

Shaped like an inverted electric light globe is this aquarium, to be hung in the window





The gold of the fish and the green of the growing plants are beautifully brought out by an electric light

Come On In and See the

Hey, Jim, Tom, Mattie, Jerry,

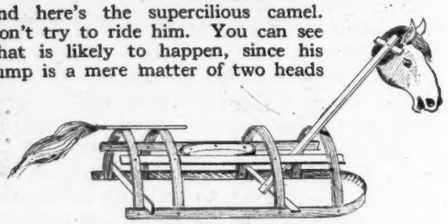
As for the leopard, your mother will make him out of some yellow cloth. You can daub on the spots of black paint with a brush

Jerry has a hard time of it playing the donkey. He's got to keep the sticks in the front legs moving and raise all the laughs he can. And if the clown kicks him in the ribs—well, he must bear it

A blanket that stretches down to the floor, a five-foot pole, Jim to play the part of the front legs and Harry the back legs—that's the giraffe. But there must be some rehearsing if the front legs are to know what the rear legs are doing

The untamed, man-defying beasts from Africa that already have killed two trainers and have decided to kill a third next week. What circus could possibly succeed without their presence?

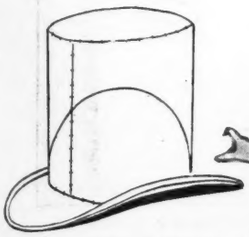
And here's the supercilious camel. Don't try to ride him. You can see what is likely to happen, since his hump is a mere matter of two heads



If you want to make a horse, use some barrel hoops and laths. The head is concocted out of pasteboard; the tail is an old rope with frayed ends

Greatest Show on Earth

let's get up a regular circus



Here's your ringmaster's hat, Bill—made from an old derby, some cardboard, and enough black paint to make it shine. As for boots, Bill, just fasten some red cardboard around the top of a pair of old rubber boots

Of course there must be a girl dressed up as Columbia. Her mother can make the costume shown here

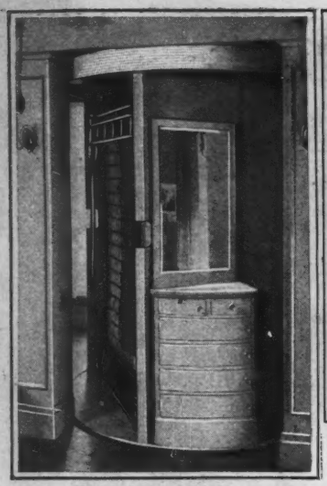
The overpowering giantess (engaged for this performance at t-r-r-emendous expense) owes her stature to a pair of stilts that any boy handy with tools can make for himself. The stick prevents her from falling

Dress up your sisters as Teddy bears and they'll make a hit. The suits are made of white bear cloth

There's simply got to be a roaring lion. No king of the jungle can look fiercer than you, Jim, draped in the fur rugs from the parlor. You'll have to make your own head

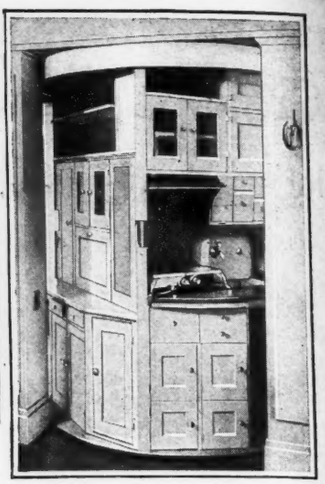
Nail the tight-rope to a board laid on two barrels. The level of the rope should be that of the spectators' eyes. Every one will think that you are a Blondin, and you will be safe

Here comes the ostrich tearing along. It's well for Mattie inside that sister Sally doesn't recognize the tail feathers that came from her hat. Mattie has a very exciting time of it chasing a dog around the ring



Now the bedroom is coming into its own

This one-room apartment may be turned into four rooms by a revolving platform which contains a kitchenette, a bed, a dresser, and a library desk. The platform is revolved by hand



The room was a library but is almost a kitchen

Presto! The Kitchen Is a Bedroom

ONE room, a revolving platform, and you have the makings of a four-room apartment. This contribution toward lowering the high cost of rent comes from Pasquali Cimini, of Buffalo, N. Y.

Mr. Cimini divides the revolving platform into four quarters: in one he puts a folding bed; in another a desk; in a third the sink, stove, ironing-board, and cupboards of a kitchenette; and in the fourth a dresser and a clothes closet. The platform is mounted on rollers, and may easily be turned by hand. All the plumbing and electric wiring terminate in a central column that revolves with the platform.

When the bed is down the kitchen is accessible from the hall and the dressing-room from the bath-room. In the central column is a ventilating duct that swallows up the kitchen smells and hat airs the bed while it is folded up.

A separate duct takes care of the garbage-pail compartment. The platform is six feet ten inches in diameter, and is seven feet six inches high; it weighs something less than seven hundred pounds. The platform, frame and partitions are all strongly constructed of steel.

Thus, instead of having one large room and bath—generously thrown in by most landlords—you will have four large rooms, though, of course, not all at the same time.

You get up in the morning, fold up your bed, and swing the platform round until the kitchenette comes in view; fix breakfast, eat it, clean up; swing your platform once again, and read the morning paper comfortably in the library.

The bath-room is so arranged that it opens out on the platform, too. Thus on wash-day the kitchenette may be swung into the bathroom and the soapsuds will splash harmlessly on a tiled floor.

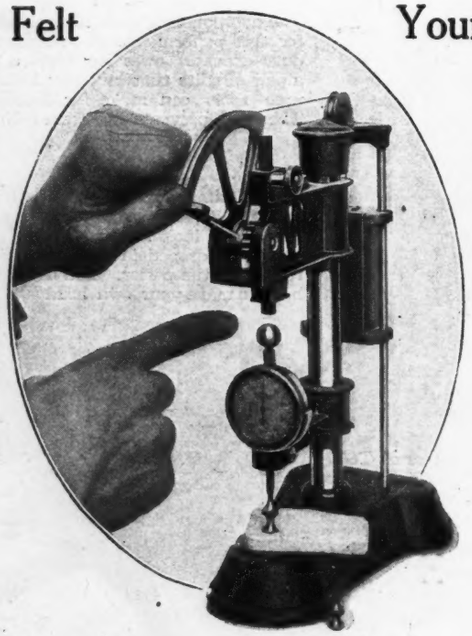
Above you see the platform in its different stages of revolution. The center picture shows plainly the possibilities of one large room when used as a bedroom. One might say that this invention will literally cause revolutions in apartment construction.

Finding the Force of Felt

AT the right is a resiliometer, a machine that measures the resiliency of felt.

You place your felt on the platform, and then let down the presser foot until it touches the felt. The presser foot is attached to a dial. One revolution of the pointer means that the presser foot has moved one tenth of an inch. A smaller pointer registers complete revolutions. You read the dial when the felt is at its normal thickness.

Then you release a spring catch which holds in place a weight attached to a quadrant. As the weight goes down the quadrant moves forward, and a bar comes down and presses on top of the presser foot. The foot sinks into the felt to the limit of the felt's compression. You now pull back the quadrant, releasing the pressure. The expanding felt will force the presser foot up, and you immediately read the dial in order to get the amount of resiliency.



When the pressure is released the felt expands, and your gage will tell you how much

Your Hard-Working Heart

THE human heart beats seventy-two times a minute, one hundred and four thousand times a day, thirty-eight million times a year. If a person lives up to his seventieth year his heart-beats—estimated according to the various averages during life—will approximate three billion beats.

At every heart-beat of an adult about five cubic inches of blood is forced out from each of the ventricles into the lungs and into the rest of the body.

In other words, with every stroke of this bodily pump about ten cubic inches of blood is expelled from the heart, which amounts to forty-three cubic inches in an hour and to a million cubic inches in a day.

As an illustration of the work done by the heart, the powerful pump of the left ventricle performs during twenty-four hours an amount equal to raising a weight of one ton to the height of eighty-two feet.

What of Tomorrow's Flying?

Is the airplane safe? Can you fly where and when you like? What's the cost?

By Waldemar Kaempffert
and Carl Dienstbach

WHEN the manufacturers of airplanes turn to the public for support, they are met with conservative skeptical questions: "Is flying safe? What about these accidents?" The manufacturers reply with statistics to prove that flying is no more dangerous than automobiling, that the blacksmiths and carpenters who built the first flimsy machines have been supplanted by engineers who test the wood, steel, and wing fabric used in construction, and that all the resources of modern science are tapped to build an airplane that is safe.

When bombs were dropped on Paris, London, Mannheim, Freiburg, and Constantinople, and whole flocks of raiding airplanes performed their gruesome death-dealing mission with clock-like precision, who can doubt any longer? As for safety, diplomats and generals, whose lives no nation could afford to risk, were transported with ease and despatch through the air. The world has literally been bombed into conviction. "The war has enlarged our mental horizon," as one British technical periodical put it.

Peace-Time and War-Time Flying

The men who guided the bombing and fighting planes over the battle-front were in a far more precarious position than any peace-time flyer will be. They were literally flung into the air and ordered to perform what was expected of them. There were no prepared landing grounds. And yet, despite this handicap, war-time flying was safer than most of us suppose.

Major-General George O. Squier, in a paper read before the American Institute of Electrical Engineers, stated that of all the flying casualties only two per cent were due to anti-aircraft fire from the ground or from enemy machines in the air and eight per cent to faulty construction. And the other ninety? Traceable directly, he assures us, to negligence, incompetence, or ignorance on the part of the flyers. If pilots are properly trained how much safer will peace-time flying become!

Moreover, the campaign in the air over the Italian front must have convinced any skeptic of the airplane's safety. Among the mountain ranges where Italian and Austrian aviators fought there was nothing that remotely resembled a smooth, safe landing green. And yet, neither Italians nor Austrians hesitated to fight or to fly over each other's territory on bombing expeditions.

You will be as comfortable in the nacelle of a fast long-distance commercial airplane as you are in a Pullman car. Luncheon will be served as it is on a railway train. You will travel in luxury. Fat men must pay more than thin men

The last piece of convincing evidence was presented when the fighting pilots literally flew to the other extreme; in other words, when they supported the charging infantry by skimming over the ground and pouring a hail of machine-gun bullets on the enemy in his trenches. What if engines had failed then? There would have been only a shell-torn No-Man's-Land on which to alight. Yet we have still to learn of any wholesale calamities that befell these low-flying machines.

And then, the night flyers—what shall be said of them? They knew only the direction in which they were to fly in order to bomb an ammunition dump or a munitions factory—nothing of the ground in the terrible darkness below. If perilous missions such as these can be carried out in safety, who shall say that when all the earth is at peace, when cities are ready to despatch and receive the winged messengers of the air, flying can never take its place in our mercantile life?

The truth is that the airplane today is in much the position of the steamship and the locomotive a century ago. Prejudice alone must be overcome. Elaborate and complicated wharves had to be created before the steamship could become of mercantile importance. Rails had to be laid, stations built, round-houses and repair-shops erected, before the steam locomotive could play its part in the transportation of passengers and freight. Similarly, a great organization must be developed before the flying-machine shall be able to realize the dream of those who would span the Atlantic in a day or wing their way in a few hours from New York to Chicago.

Needs of the Airplane

The flying-machine traverses the pellucid air unhampered by hills or poor roads. But that is not enough. Before commercial passenger-carrying airplanes appear in large numbers, before airplane touring shall become as common as motoring, the face of the earth must be prepared. Although the flying-machine is a thing of the air, it must start from the ground and it must alight on the ground.

Here and there are a few army aviation fields. More, much more, must be done. Every civilized country must survey itself with a critical eye and note what localities are best suited to serve for landing and alighting. Between New York and Chicago,

for example, prepared aviation fields should be found at intervals of not less than one hundred miles.

Now, to dot a whole country with hundreds, even thousands, of aviation fields is a task of such magnitude that only a government can accomplish it. Mindful of this, the United States Army has already addressed itself to the task. Chambers of Commerce all over the country have been asked to study the country around their communities and to indicate those localities that seem best fitted for landing fields. The Government knows exactly what it wants. It has sent Chambers of Commerce plans of aviation fields and of the sheds and repair-shops to be built.

The preparation of the ground will make the flying-machine absolutely safe. Automobile engines now stall in the middle of the road. Flying-machine engines also stall in the air. The passengers of a touring car have only to step out on solid ground and walk if the engine should fail them; but, in a similar predicament, the man in the air must glide down to the ground.

The Higher You Are, the Safer

Paradoxically enough, the higher you are in a flying-machine the safer you are. When an engine balks at a height of a mile or so, you cast your eye about for a smooth piece of turf. You may glide from three to five miles by skilful handling of your craft. Is it not obvious that with Government airdromes everywhere you will be sure to find an alighting place?

The flatter the angle at which a flyer alights, the safer for him. Hence the field must be open from all sides. If it is fringed by trees and buildings the flyer must plunge down too steeply for safety; it will be difficult for him to flatten out at the right moment. The difficulty of landing at high speed has probably been greatly exaggerated. We have only to consider that fighting flyers in their high-powered machines landed safely at sixty miles an hour. If the ground can be approached at a very flat angle the pilot has less to fear from impact with the solid earth at high speed than from the momentum that must be expected in taxiing over the ground.

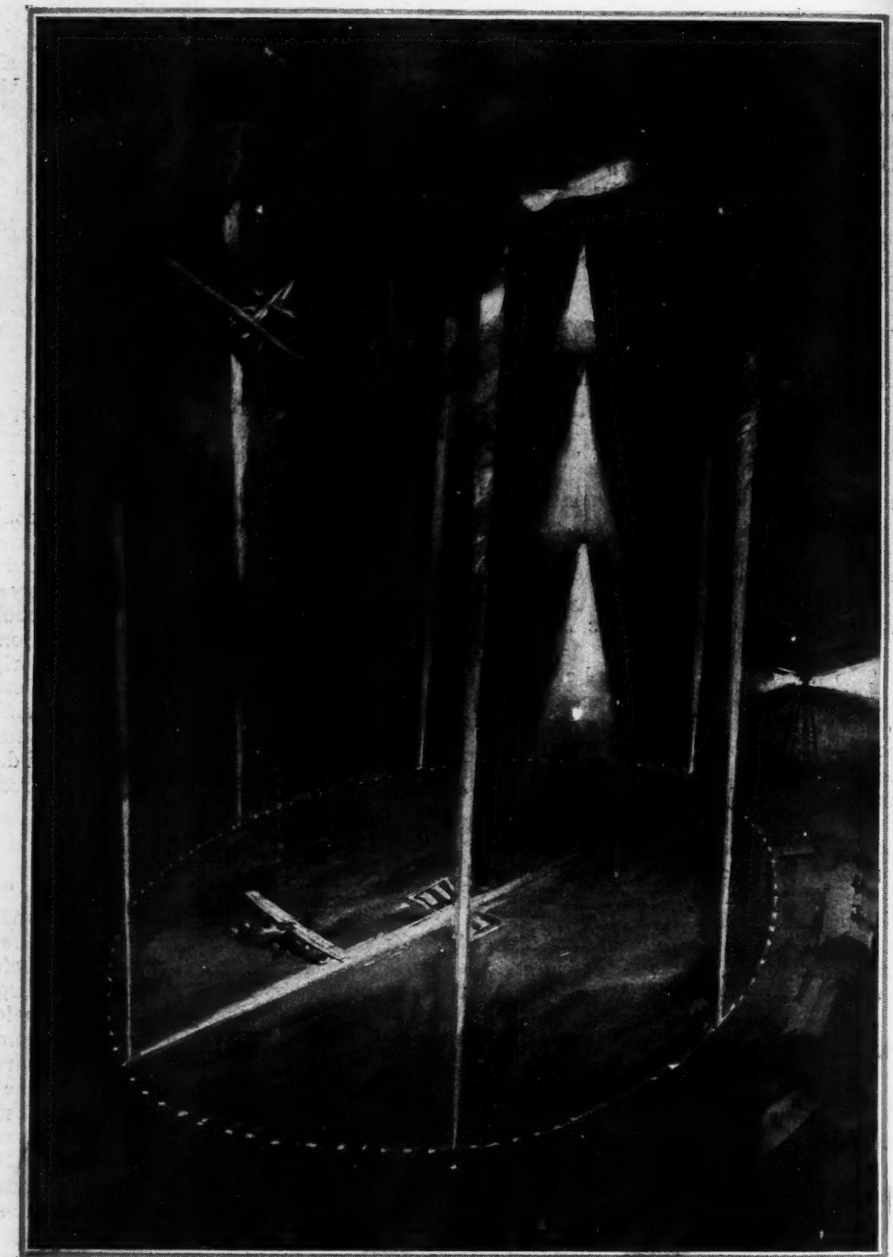
The flying-machine needs brakes of some kind. Why not apply the usual band-brakes to the wheels? Because a machine that is held back below its center of gravity will somersault at high speed. Perhaps the solution is to be found in some method of forcing the tail down with tremendous leverage while the brake is applied. A horizontally mounted propeller at the end of the tail might answer the purpose—a propeller which, during flight, may be held parallel to the fuselage, so that the head resistance is not increased. It is even conceivable that the self-starter of the engine may be used to drive the horizontal propeller during the short period when its services will be required.

It may be urged that this problem of holding the tail down while the brakes are applied is not easily solved. It entails, for instance, the use of a device to prevent an increase in the angle of incidence of the wings, so that the machine may not rise from the ground in the effort to check it.

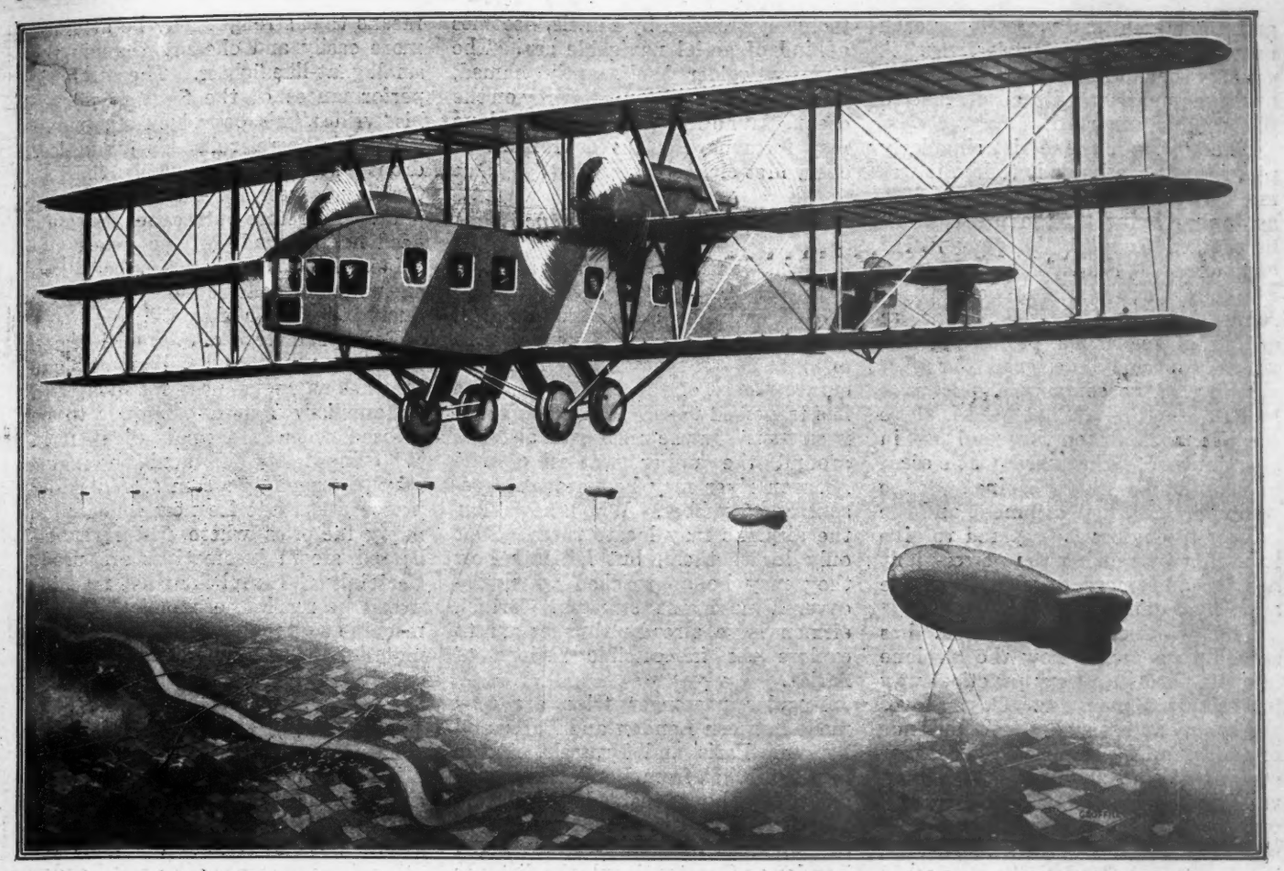
When landing and launching grounds are to be found everywhere, it will be possible to design the small inexpensive airplane—the machine that can be kept in a kind of garage and trundled out as readily as if it were the cheapest of Detroit automobiles. Capacious fuel-tanks will be unnecessary. It will be possible to refill the tank every hundred miles, if need be. Because no extraordinary feats will be demanded of it, the engine need not be of the enormous power demanded by the fighting flyer.

Government Aviation Maps

Maps, too, must be issued by the Government—maps to indicate the best route between two given points.



At night the aviator will be guided to his landing place by the beams of powerful searchlights directed upward, as well as by captive balloons to whose cables electric lights are attached. Nothing must be left undone to insure the flyer's safety



The airplane builders, at least, are convinced that the era of air transportation is here. This machine is not the creation of an artist's fancy, but is designed by an English firm (the Bristol Company) for actual immediate construction To guide the navigator in a fog, captive balloons will be used—buoys of the atmosphere

This means the careful exploration of the entire country from the air pilot's point of view. Enormous as the task may seem, it is far more easily accomplished than may be suspected. The army dirigibles have only to be pressed into service—craft that may fly as low as they please and photograph at leisure the territory below.

Miracles in photographic map-making were performed during the war. Similar miracles must be performed to chart the country for the pilot of the future. His map must indicate the meteorological characteristics of the region over which he flies—must tell him the direction in which the prevailing winds blow, what invisible atmospheric perils are to be avoided, how high to fly over a given region, and the hundred and one facts that he must know in order to reach his destination quickly and safely.

We talk a good deal about the weather nowadays; we will talk far more about it when a whole people takes to the air. The Weather Bureau must prepare to extend its activities. Its local reports and maps must be even more practical than they are now; they must tell a man exactly how he must fly to any given point within a radius of one hundred miles.

At present the Weather Bureau concerns itself but little with the influence of the ground; but it is precisely the influence of the ground that makes flying favorable or unfavorable in a given region. An invisible surf of air is dashed up against every mountain. A lake, a grove, a collection of buildings, in a word, every protuberance, has its effect in forcing air-currents in this direction or that. And all these invisible disturbances the Weather Bureau must visualize for the airman.

Fog will be the only peril to be feared. But even fog will lose much of its terror when the Government has carried out its plan of establishing radio beacons all over the country, to extend its airplane mail service.

Radio Beacons Will Help

What is a radio beacon? Simply a station from which wireless waves are sent in all directions, to be picked up by the flyer lost in a fog or groping his way through the night. Part of its radio equipment is the direction-finder —a mere loop of wire that can be swung in any direction on a vertical axis. When the loop is turned in the direction of the oncoming waves the beacons' signals are received most clearly; when it is turned at right angles nothing is received. "I am Louisville," "I am Toledo," "I am Easton," beacon after beacon will literally shout at regular intervals with the aid of automatic sending devices. And hundreds of pilots in the air will hear and guide their machines unerringly toward the particular beacon that is their destination.

The commercial companies will surely equip their large passenger-carrying planes with such radio conveniences. But what of the business man or the tourist who flies alone in a machine unprovided with such aids? Balloons will guide him—great captive balloons floating high above the fog and illuminated at night. Every landing field will thus literally rear its head above the clouds. The flyer sees the light and heads for it. He has but to spiral down around the cable that holds the balloon captive to reach the ground below in safety. Ground lights will make his landing safe.

In his "Night Mail" Rudyard Kipling suggested a plan that may also be realized in order to make flying safe at night. He drew a picture of searchlights throwing their gleams vertically into the sky—impalpable, luminous sign-posts that point the way when the night is clear. What a wonderful spectacle will be presented to the man in the air as he flies from New York to St. Louis through the night! His lane will be as plainly marked-out for him as are his electrically illuminated streets at home. For miles and miles he sees the long, stiff pencils of light thrust upward from the

ground or great captive balloons each bearing a powerful electric light. A country road at night would be dangerous in comparison with an air-lane so painstakingly marked.

The flying-machine is singularly plastic. As we know it today, it was molded to meet the exigencies of war; as we shall know it in the future, it will be molded to meet the demands of commerce. It is adaptable. The man who fought at a height of twenty thousand feet placed his reliance on an engine of enormous power, and on wings especially designed for fast climbing. The commercial pilot will be less exacting. What need is there for him to climb ten thousand feet in six minutes? What need has he of an extraordinarily high ceiling? He wants engine trustworthiness, and the builder of engines is prepared to give it to him by making the power-plant heavier and more durable than the army flyer demands.

The war, curiously enough, has served to show us how the airplane may be used in a very practical way for scientific purposes. To fly over the enemy's lines and make thousands of photographs of positions is the exact equivalent of mapping a jungle or a wilderness which may be penetrated only at the risk of life and the suffering of untold hardship. In a single day the Coast and Geodetic Survey could thus perform more useful work than it now accomplishes in months when it surveys remote islands in the Pacific or the wilds of Alaska.

Fire-Extinguishing Bombs

Already the Forest Service is planning to use the airplane to detect forest fires and to extinguish them by dropping upon them bombs containing fire-extinguishing chemicals. The Coast Guard will find its task of locating and blowing up derelicts at sea reduced to a matter of hours when it enlists the seaplane into its service.

During the war the British dropped food into towns beleaguered by the Turks. Why may not bomb-carriers supply colonies devoid of roads or railways with the material that they need? The Sahara Desert, now painfully and tediously traveled by camels, becomes a kind of aerial navigable sea. The German raider *Wolf*, aptly named, used a seaplane to locate its prey on the ocean. Who knows but the seaplane may form part of the equipment of every first-class steamer?

Exploring by Airplane

With what ease will the airplane transport the explorer over mountain ranges, swamps, jungles, and deserts! The camera will enable the explorer to bring back a far clearer, far more accurate record of the country that he has traversed than if he had explored it on foot. In the uncharted districts around the upper waters of the Amazon river may be untouched resources of rubber. Who knows but the airplane may locate them? Not only locate them, but indicate how they may be approached by undiscovered navigable streams? British airmen have already thus begun to explore the inaccessible regions of Africa.

Regular passenger trips are now made between London and Paris and between Paris and Brussels. Rome can be reached from London in twelve and a half hours instead of in forty-two as at present; and Marseilles in eight instead of twenty-three. From London to Constantinople the distance is but twenty hours by airplane, compared with seventy-two by rail. The machines planned for this service are vessels of moderate size equipped with three hundred horsepower engines. They ought to carry forty-four hundred pounds of revenue-paying load in addition to the pilot, mechanic, and fuel. The cost per passenger mile would be a little less than $2.75.

There is no reason why the peace plane should not be far cheaper than the fighting war plane. Remember that the fighting machine had to be extraordinarily light. It was not intended to stay in the air more than two or three hours. But a limited amount of fuel was carried in order that its climbing ability might not be impaired. Even the amount of ammunition for its machine-gun was limited.

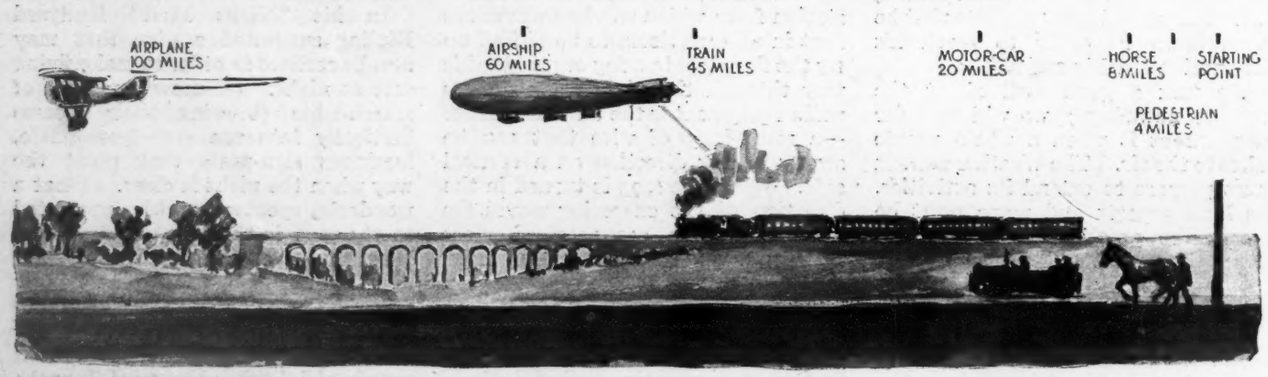
The peace plane may be larger. This means that strength may be attained more easily and cheaply than in the small gnat-like fighter. The acrobatic performances of the fighting pilot—his "vrilles," his loops, his Immelmann turns, his barrel rolls, his falling-leaf drops—will play no part in the less thrilling career of the commercial pilot. Therefore outrageous demands need not be made on the peace machine. All this tends to simplicity and cheapness of construction without reducing the factor of safety.

Perhaps, instead of the multi-engine machine, we may have an airplane that has an engine used for flying and an auxiliary source of power to be utilized when the main plant fails. Who knows but this auxiliary engine may be driven by steam stored under pressure—a practice now followed in many factories where fireless superheated steam locomotives are used? Certainly the multi-engine machine would be far less economical than a machine equipped with a single flying motor supplemented by an auxiliary engine.

Will Commercial Flying Pay?

Will commercial flying pay? People asked themselves a hundred years ago: Will railways pay? Flying will pay simply because it is fast. Only the other day the owner of a great London department-store flew to Brussels in order to hold a conference with his branch manager there. He saved days in actual time and thousands in money—so he later reported.

Whenever the object to be gained is dependent on the saving of time, it will pay to travel by air. It will be expensive, to be sure, to convey one, three or five passengers a distance of five hundred, a thousand, or fifteen hundred miles. What if the fare is two hundred dollars, five hundred dollars, or even a thousand dollars, in comparison with the profits to be made in furthering an enterprise that means a return of perhaps millions? Who would not be willing to pay one dollar to have an important letter conveyed by air from New York to Chicago in order to receive a reply the following night at the cost of another dollar?

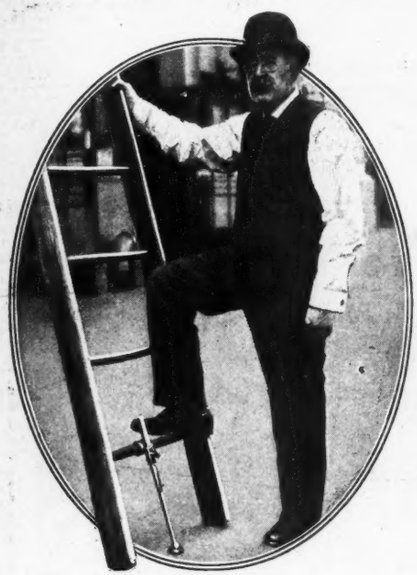


What an hour's travel meant yesterday and the day before, and what it will mean tomorrow

The Stay that Stays the Ladder from Falling

IF the ladder slips from under you while you are painting the house, you unfortunately come down after it, and are apt to get severely bumped, bruised, and painted. Perhaps Mr. James Maxwell, of New York city, has so slipped, for he has invented a "ladder stay" which helps a ladder to stay put.

The stay is a metal rod resting on a rubber pad, which rests on the ground. It is fastened in place by means of a screw, which is attached to the holder through which the rod passes. The holder itself is part of a two-pieced tubular clamp that fits around the ladder rung and is held together by screws. It is screwed on tightly enough to keep its central position on the rung, and yet not too tightly to keep it from revolving around the rung for the purpose of adjustment.



The ladder will not slip from under him on account of the stay attached to the lowest rung; he is the inventor thereof

Coal arrives by way of an elevator and a moving belt across the top and is stored in the four large bins

An Elevator for the Coal-Bin

"CLEAN Coal," says the fence of the coal-yard shown above; and the bins just behind help to prove it, for in them some of the coal is stored—free from dirt and refuse.

The bins are twenty-five feet in diameter and thirty feet high. They are made of two-by-four planks, held together by iron bands spaced twelve inches apart. Across the top of the four bins runs a moving belt.

In unloading coal-cars, the coal is dumped into a hopper which is raised by a bucket belt to the top of the bins. The coal then moves along the belt on top and drops into the bins below it. The power is supplied by a fifteen-horsepower motor.

Each bin has a chute in its side about eight feet from the ground. These chutes are used for loading trucks directly from the bins. The trucks draw up underneath the chutes and the chute doors are opened.

Who Are You, Anyway?

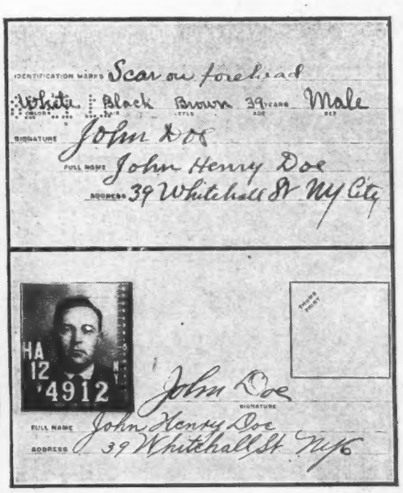
WAR conditions made it imperative to use the utmost caution in protecting the military and naval depots of the United States Government from spies and other undesirable hostile intruders. In view of the fact that thousands of persons were regularly employed at these depots, and that hundreds of persons visited the depots daily on legitimate business, some method had to be devised to make strict supervision possible.

Casual visitors were admitted on presentation of a temporary pass issued by the identification bureau of the Quartermaster's office. The card contained all necessary data for the positive identification of the bearer; and a similar card, containing in addition a portrait of the bearer of the pass and his thumb-print, was filed in the office for reference and comparison.

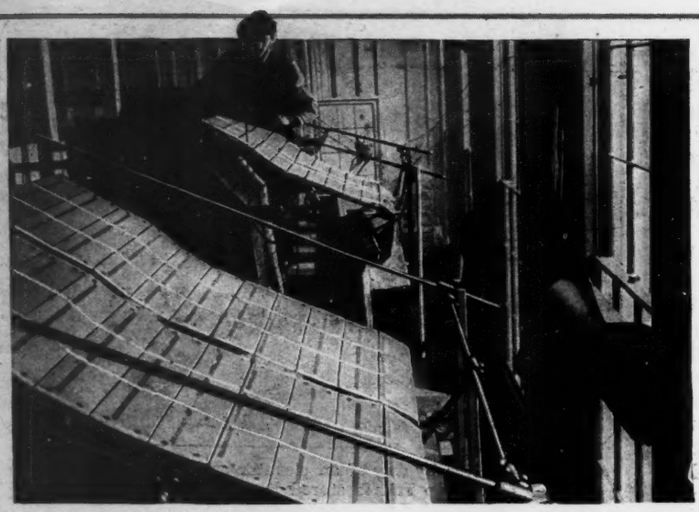
To all regular employees button badges were issued, showing a picture of the bearer, his height, his number, and the index letters and number under which his record was filed. A specially designed machine was used for stamping the pin-badges, which had a metal back and frame enclosing the bearer's photograph under a transparent cover.

During the war every employee at the United States army and navy depots was required to have a photograph button. At the right is the camera that made the photograph; it also registered each person's height and gave him a number

Stamping together the photograph, its cover, and metal back



Casual visitors were required to have a pass containing data for identification—shown in the top picture. The lower card, carrying the thumb-print was placed on file

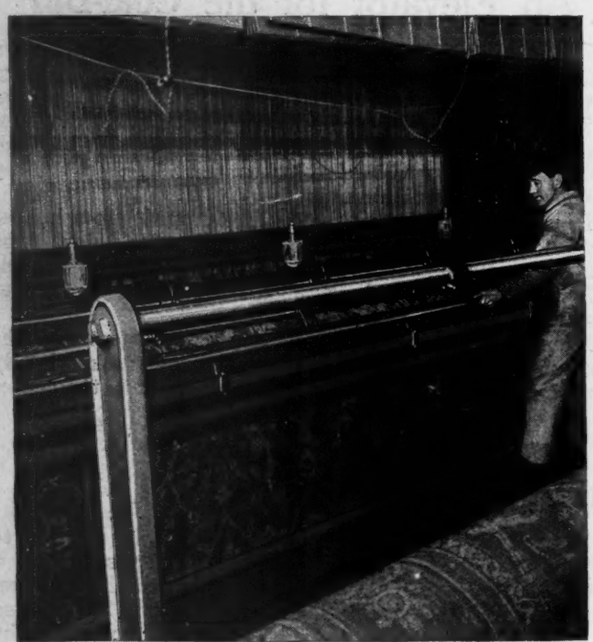


How That Carpet of

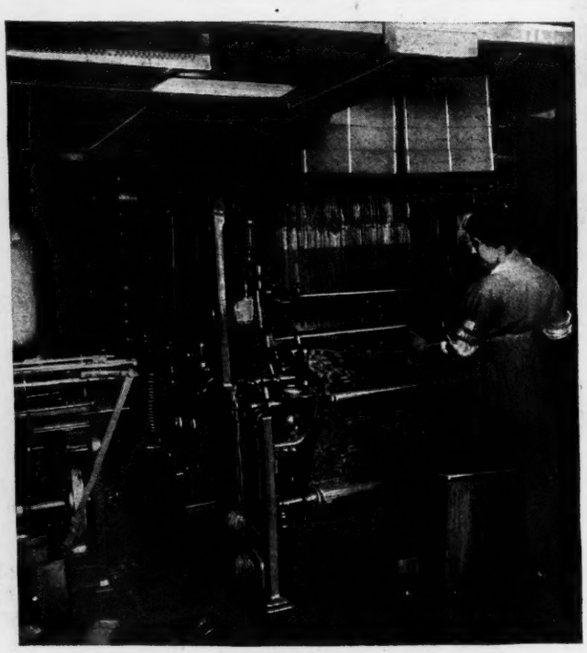
Carpets are woven very much piano. Instead of a roll of the yard) perforated cards (they M. Jacquard, a French invent- forations automatically govern

Photographs © Underwood & Underwood

Left. Perforated cards ("jacquards") control the weaving of the carpet's pattern, just as a perforated paper roll determines what notes of music are to be played on a player-piano

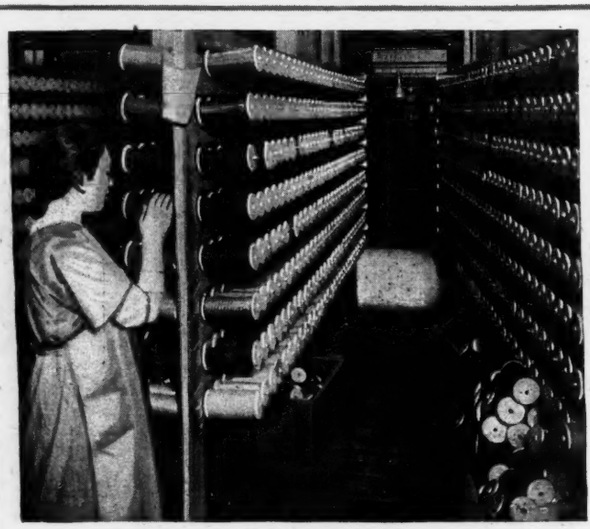


Here is a big rug loom in action. Overhead are the jacquards, or perforated cards, that automatically control the weaving of the pattern



A carpet loom is as automatic as a player-piano. You adjust perforated paper cards, and the machine weaves a carpet with the desired pattern

Left: The carpet is passed through a shearing - machine. The revolving knives cut off the excess material

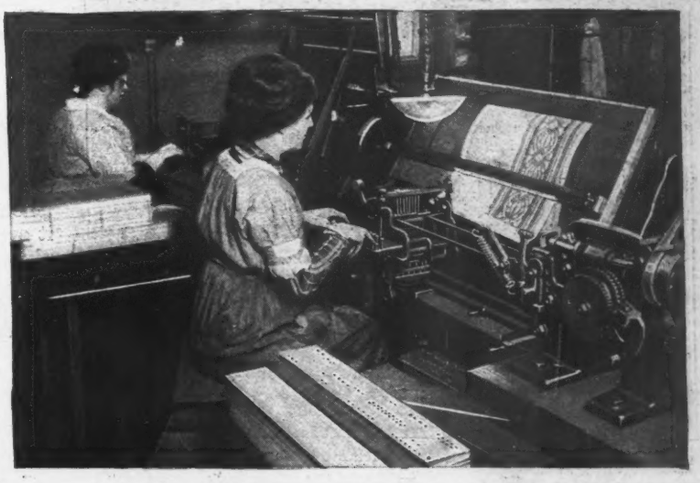


Right: Spooling the colored yarns that go to make up the pile of a carpet

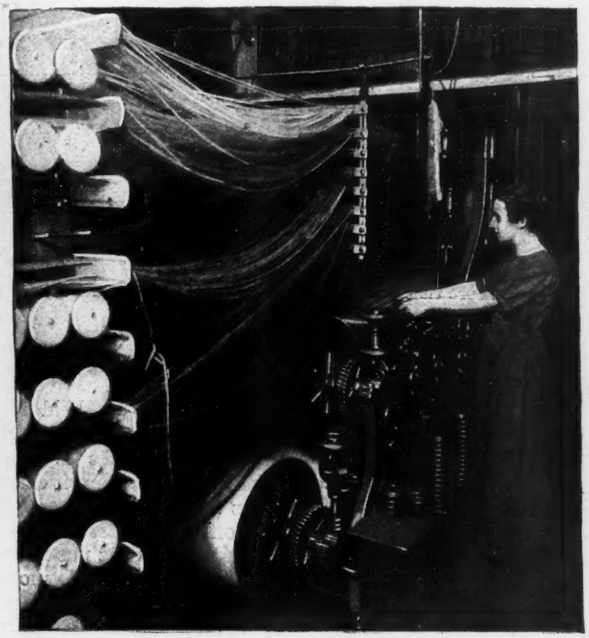
Yours Was Made

as you play an automatic
paper (jazz or Beethoven by
are called jacquards, after J.
or) are slipped in. The per-
the weaving of the pattern

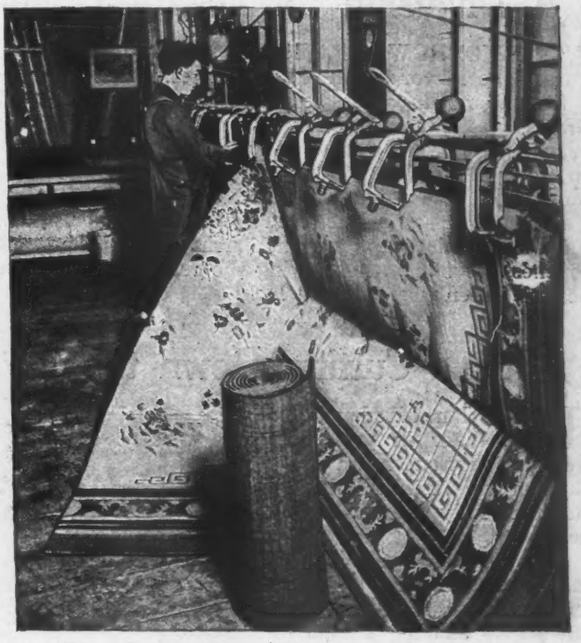
Photographs © Underwood & Underwood



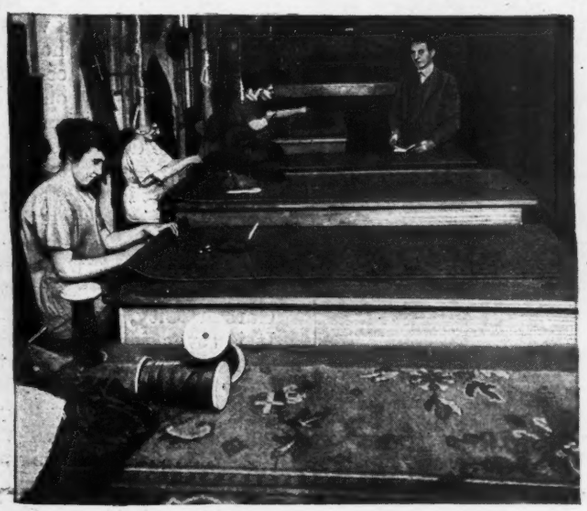
Right: The jacquards are perforated in a machine that is operated like a typewriter. The operator follows a painted design. The number of cards equals the number of weft threads in a pattern



This is a rear view of a carpet loom; it shows the colored yarns on their way to the pattern-controlling jacquards; women are largely employed in this work



This strange contrivance is simply a huge sewing-machine overcasting breadths of woolen carpet in order to make one large rug



Left: Imperfections in the machine-made carpet are "doctored" by expert hand weavers

Right: Cotton warp entering a carpet loom. Cotton is the real foundation of every good carpet

You can inspect the audience without turning your head

A Diversion for Theater-Goers

"'TOMORROW will tell!' said the hero grandly; and the mirror fell on the second act."

Strange reading; yet words like these may appear in dramatic columns before long, for the idea of mirror drop-curtains has been revived. Sir James Barrie brought it to life again, and Mr. Albert de Courville is planning to build one for his "Little Theater" in London.

It will be raised and lowered by electric power, and will have air cushions to prevent jarring when the curtain touches the stage, thus saving the curtain-raiser from a possible seven years of bad luck.

The Glad-Handed Door

THE storekeeper who has large red "welcome" signs pasted all over his windows will be interested in a new invention by Robinson H. Harsh, of Chicago, for reassuring the timid public. It is an outstretched tin hand to be used instead of the stupid round door-knob. It is attached to the door-latch, so that when a customer shakes it the latch will be raised and the door will open. The hand is conventionally clad in a cuff and coat sleeve—it even has finger-nails. When you grab it you have the pleasant sensation of shaking hands.

The inventor wisely suggests that the hand be used only on the outside of the door. You may not feel like shaking hands on your way out.

When a door gives you the "glad hand" you may be sure that you are welcome in the store behind it

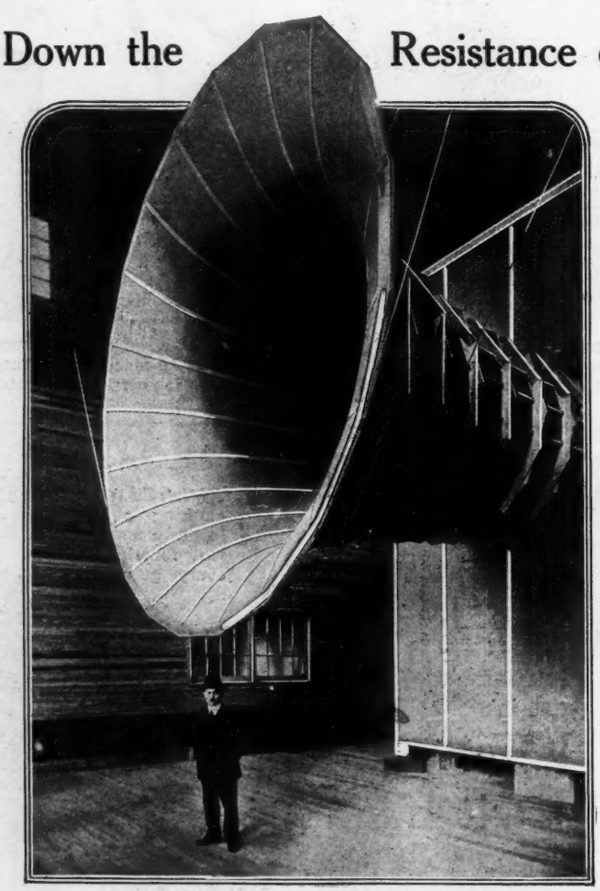
Cutting Down the Resistance of Airplanes

THE airplane of today does not differ in principle from the first successful machine of the Wright Brothers. But it is fully four times as fast.

This increased speed is obtained not merely by the use of more powerful engines, but by so shaping the surfaces that air resistance is reduced to a minimum. When you increase the speed of any moving object from twenty to forty miles an hour, you do not simply double the air resistance—you quadruple it. Air resistance increases as the *square* of the speed. Everything depends on correct designing—on reducing resistance.

So important has the consideration of air resistance become in building machines for fast flying that the resisting effect of every projection is studied. Turnbuckles, wires, even the helmets that the aviators wear, all are given the least resisting shape.

Now, in order to discover what is the most efficient surface, the wind-tunnel is used. A little model of the surface (a whole machine, or a wing, or a fuselage) is held in a stream of air. The little model's resistance is measured by the pull that it exerts. Thus is discovered the shape that offers the least resistance. Obviously, it does not matter whether the model is moved in still air at the right speed, or whether the model is fixed and the air moves: the result is the same.



©Keystone Photo News

It looks like a gigantic talking-machine horn, but it is the intake of Glenn H. Curtiss' seven-foot wind-tunnel, used for testing airplane models

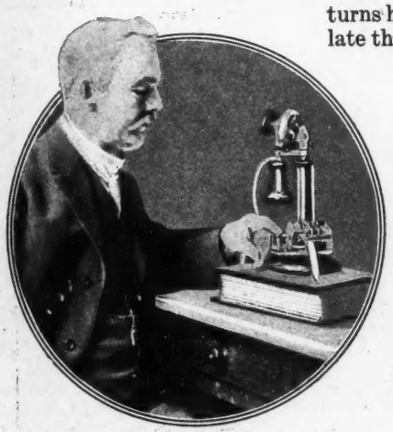
When the air is being sucked through at a speed of one hundred miles an hour, the pressure on the walls of the experimental house in which the tunnel is contained is about thirty-six pounds per square foot. It is impossible to open the door leading into the house, even though you press against it as hard as you can with your shoulder.

The largest wind-tunnel of its kind is that which Mr. Glenn H. Curtiss has built at Garden City, Long Island. It is seven feet in diameter. The air is sucked through the tunnel by a powerful three-bladed propeller, driven by a four hundred horsepower motor. The accompanying picture shows the collector end of the tunnel.

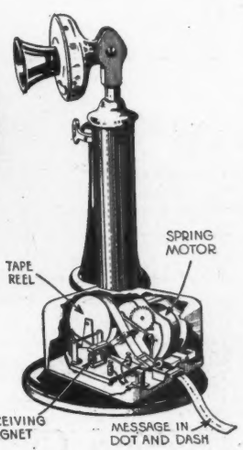
Who Called? The Ticker Tells

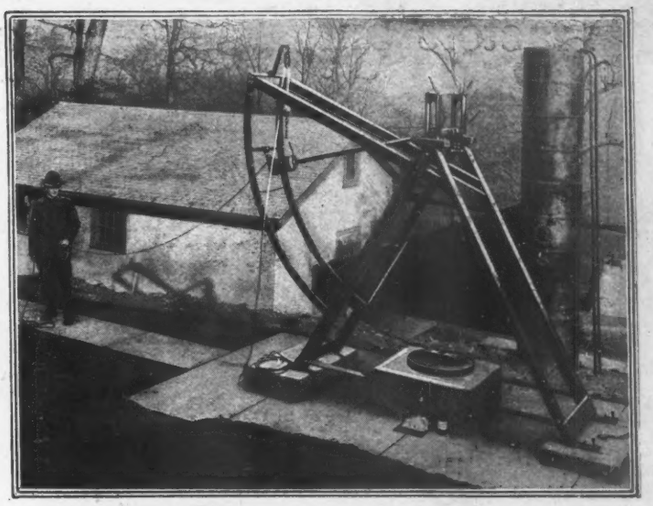
"THEY don't answer," singsongs Central. You hang up your receiver disgustedly as that same nickel rattles back for the fifth time. If only you could leave word that you have called! Ah, but Arthur Engelberg, of Oakland, California, has recently patented a device for doing just that.

It is a telegraphic arrangement, much like a news ticker, and is attached to the base of the telephone. When "your party does not answer," you leave word with Central to have him call you. Central tells the telegraph operator in the office to notify Broad 900 that South 450 called. The telegraph operator is then connected with the absent Broad 900, and she sends a dot-and-dash "call South 450" over the wire. The dots and dashes register on the ticker tape at Broad 900, and when the absent one returns he need only translate them into words.



"Call South 450," said the ticker tape when this man returned; he is the inventor of the combined telephone and telegraph arrangement for registering numbers that have called you while you were not there





When he pulls the cord, the weight will fall and hit the explosive on the anvil. The pendulum always hits the explosive at the same angle. This is how the Bureau of Mines tests its explosives

Will It Explode?

HE pulled the rope, down came the weight, and *bang!* the powder exploded. It looked as if he were celebrating the Fourth of July with a new kind of powder cap and stick, but in reality he was very seriously testing the sensitiveness of a commercial explosive to friction. He had placed the explosive on a steel anvil, and by releasing the pendulum weight had subjected the explosive to a glancing blow.

The forty-four-pound steel weight is faced with hardwood fiber. It swings down from a height of fifty-four inches. This equipment is used by the Bureau of Mines for testing a great variety of permissible, high, and military explosives. It is located at an experiment station near Pittsburgh.

This pendulum friction device is a vast improvement over the broomstick method of testing explosives which was formerly used. The explosive was subjected to the glancing blow of a hand-operated broomstick. There was no uniformity in speed or in the angle at which the explosive was struck. A pendulum, when released from a fixed height, will always hit the explosive at the same angle and at the same gravity-controlled speed.

One Way to Make the "Sanitary" Fountain Sanitary

ONE large railroad, which installed more than a hundred "sanitary" water fountains in as many of its stations, found upon testing them that they were by no means safe. Germs of pneumonia, diphtheria, and scarlet fever were plentiful on various parts of the fountain, and even typhoid and other dangerous germs were not always absent.

Where did the germs come from? The mouth of the drinker as it comes in contact with the metal or enameled parts of the fountain.

When the United States entered the war, and it became necessary to provide sanitary drinking fountains for the army cantonments and camps in this country and in Europe, a type of fountain developed by a manufacturing concern in Ohio was selected.

In this fountain the water issues in two streams from the side of the fixture. The two streams are placed at a slight angle to each other, and the user's mouth is placed at the point where the streams meet. An enameled guard prevents the mouth of the drinker from touching the fixture.

It can be used either for drinking from directly or for drawing a glass of water

Keep Out These Aliens

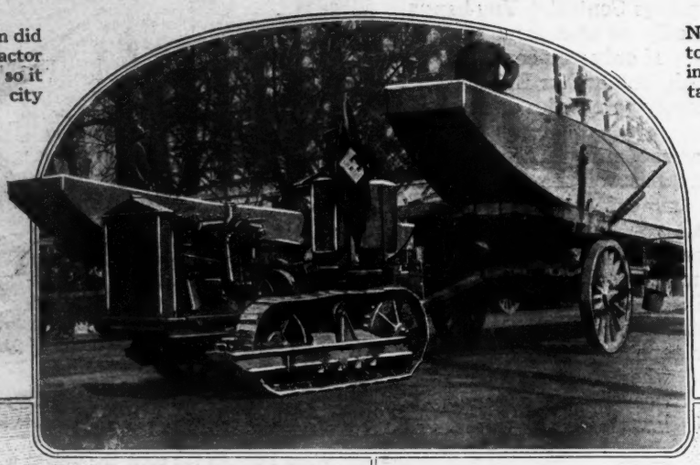
NEW YORK is very particular about whom she lets into her port; each incoming ship must stop at quarantine and pass a rigid health test before the people on board are allowed to land. This is to prevent the bringing of foreign disease and possible plagues into the country.

Yet, strange to relate, we allow these same ships to dump earth ballast wherever they choose in the East River, the Hudson, and in all parts of New York bay. Thus we run the great risk of having undesirable plant growth and accompanying plant pests.

The United States Department of Agriculture warns us that, unless this habit stops, soil-infecting diseases, injurious nematodes, and hibernating insects may spread over the whole country. The Department of Agriculture is investigating the matter.

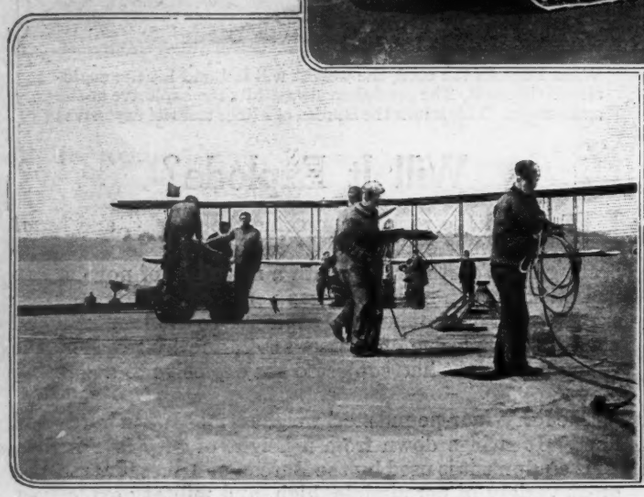
Tractors and Tanks Today Get Peace-Time Jobs

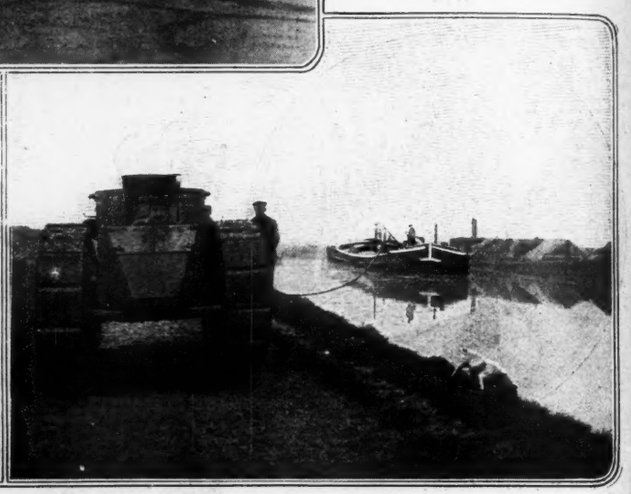
Simple life on a farm did not appeal to the tractor shown at the right, so it moved to a big city



Now it hauls huge pontoons for bridge-building; this picture was taken in Washington

Out of the water on to the sand. Tractors haul the great seaplanes to their hangars when the day's work is done; one tractor is capable of handling each plane





They are using tanks for tug-boats on the Marne canal in France; one small Renault tank is able to haul four heavy barges at the rate of two miles an hour

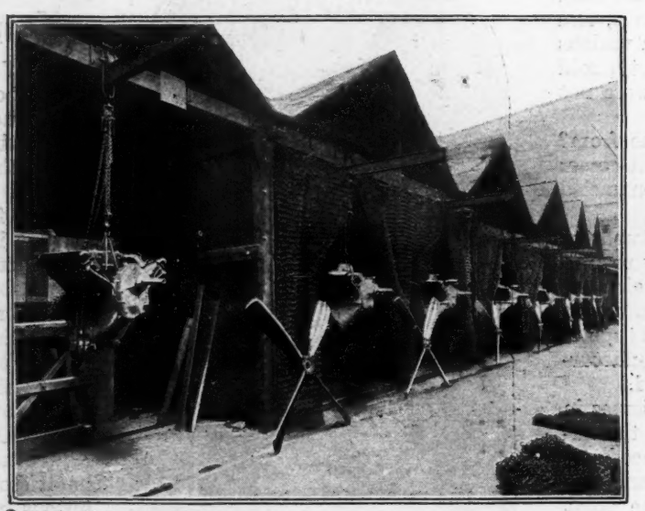
Testing Airplane Engines Behind Chain Curtains

THE airplane engine is a wonderful piece of mechanism. It must be compact, because space in the fuselage is extremely limited. It must be light in proportion to the horsepower developed.

Try to imagine an engine capable of developing one hundred and thirty-two horsepower which weighs only one hundred and ninety-four pounds. Not all engines are equally light in comparison to their horsepower, but only in a few of the largest and heaviest types does the relative weight exceed two or three pounds per horsepower. That means that the material must be able to withstand enormous strain while the engine is working under extremely high pressure—as high as one hundred and twenty-nine pounds to the square inch and making from twelve hundred to twenty-one hundred revolutions a minute. Think of the terrific strain upon the engine and its propeller cleaving the thin air in high altitudes at maximum speed, and you will understand that an engine upon which such extreme demands are made must be thoroughly tested before it is placed in commission.

Every airplane engine must be tested under running conditions; therefore, in all factories where large numbers of such engines are built, special provisions must be made for protecting the life and limb of mechanics engaged in making the tests. There may be the slightest defect in the material, a defect so minute that it escapes the scrutiny of the eagle-eyed inspectors, a weak spot or a lack of proper adjustment which manifests itself with startling vehemence during the test. A pipe or a cylinder may burst; the crank-shaft may break; the propeller may fly to pieces.

In the airplane factory of an English company every engine to be tested is temporarily mounted on a framework in one of the stalls, the sides and fronts of which are made of heavy chain curtains. Protected by these curtains, the workmen and engineers can observe the working of the engine without risk of injury should the propeller fly to pieces.



© Wolseley Motor Company

When the engine is to be tested, the heavy chain curtains are closed over the front to protect the workman from injury in case of accident

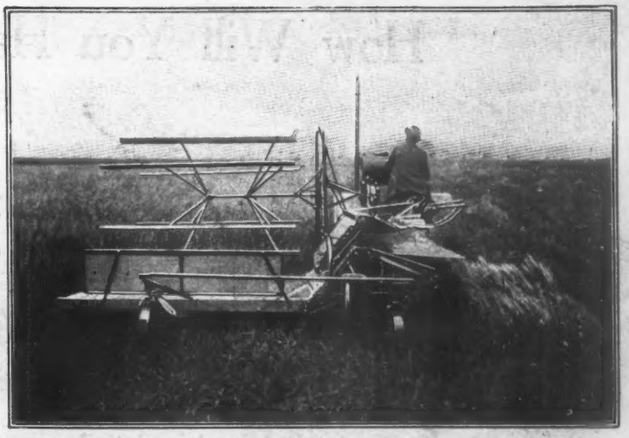
Carry a Saw in Your Pocket

IT will curl up and nestle harmlessly in your pocket; but when you take it out and open it, you will find it a dangerous thing to play with, for its teeth are so sharp that they will cut through wire, or even trees, very easily. Such is the folding saw shown below.

The segments are studded with small pieces of very high-grade steel that are well sharpened. When the saw is stretched out its full length it measures a yard. There is a ring at either end for handling it.

The saw bears the old but still remembered "Made in Germany" stamp. It was brought here by an American soldier who had already collected an Iron Cross and a "Gott mit Uns" belt-buckle. He found the saw in No Man's Land, and says that the German who owned it had used it for cutting down barbed-wire entanglements. We present the idea here, thinking that the saw may have some peace-time use.

When curled up, this saw is quite harmless and will fit into your pocket; but when it is stretched out to its full yard length, the sharp teeth are exposed



This tractor binder has dealt poor old Dobbin another knock-out blow. A few more and Dobbin will have to take the count

Farming Under the Sign of the Iron Horse

FARM tractors have long been employed for hauling plows, cultivators, planters, mowers, and reapers; and now a Western manufacturing concern has placed in the market a horseless binder, propelled by a gasoline-engine tractor which also supplies the power for operating the binder machinery. The binder is hitched to the tail end of the tractor, and receives its power from it through the medium of a tumbling-rod. It is comparatively light of weight, and it can be operated successfully by one person.

Tractor binders of the type shown above are of particular value on farms of large acreage; but even on smaller farms they may be used at a saving of expense if a number of farms club together

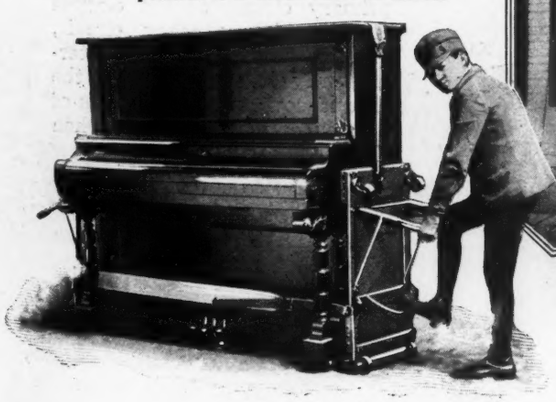
Helping the Hard-Working Piano-Mover

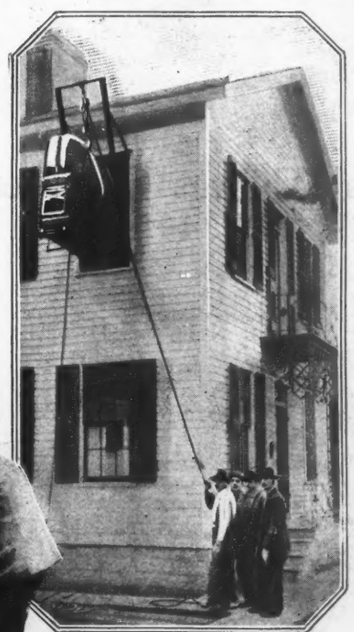
JUDGING by the crowds that gather at piano-hoistings, the general public enjoys them—but not so the hoisters. Their job is a difficult and clumsy one; for a piano is about the unwieldiest thing made.

The so-called "self-lifting piano-sill" is intended to make the piano-mover content with his lot. It is a platform with two handles and with rollers at both ends, and is attached to the lower end of the side of the piano by means of a hook-shaped lever that fits underneath the piano. By pressing down on the handles you can raise the piano off the floor. These platforms are strapped to the ends of the piano.

After the piano has been raised from the floor, it is easily rolled about on the casters at the sides, even when it is standing on end. The handles that do the lifting may be folded in, out of the way, without disturbing the position of the piano.

By pressing down on the handles he raises the piano from the floor; in this position it is much easier to handle





Almost in: the casters make it possible for the men to roll the piano on its side after it lands

Cleaning London's Air

UNSUSPECTING Londoners would probably be very uncomfortable if they knew what the Atmosphere Pollution Research Department recently discovered about their city: that each cubic inch of air in the vicinity of London contains six million particles of dust. Pure mountain air contains only thirty thousand such particles to the inch.

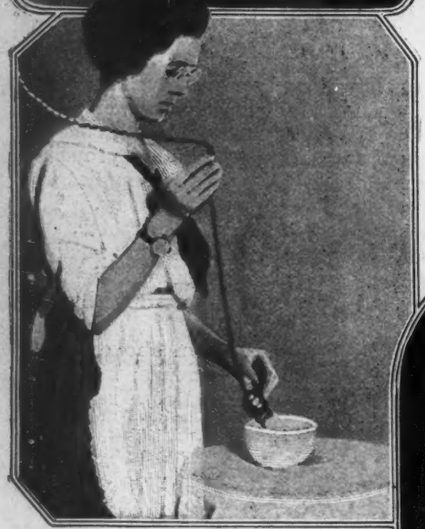
Germs, too, are so plentiful that it is estimated a man putting in a ten-hour day in the City inhales some thirty-seven million microbes of all kinds.

It has been put up to the Atmosphere Pollution Research Department to find a remedy.

How Will You Have Your Eggs?

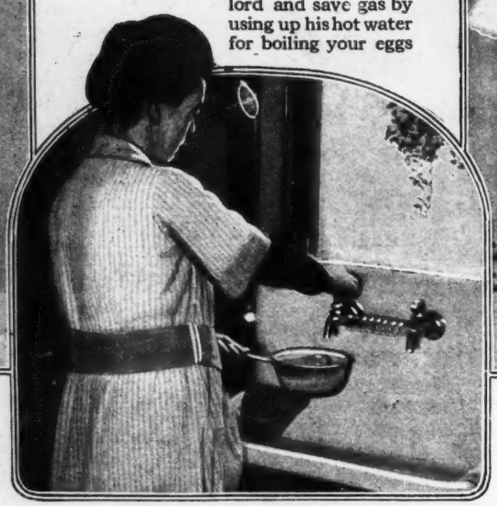
Roast 'em in hot ashes! Though this method smacks of the Spanish Inquisition, roasted eggs make good eating

Boil 'em, not in oil, but in a hot spring. The lady below is dipping an egg in one of Yellowstone's springs



A cup of water, one fresh egg, and one lighted electric bulb, mixed together, is the latest recipe for soft-boiling

Take out your grudge on the landlord and save gas by using up his hot water for boiling your eggs

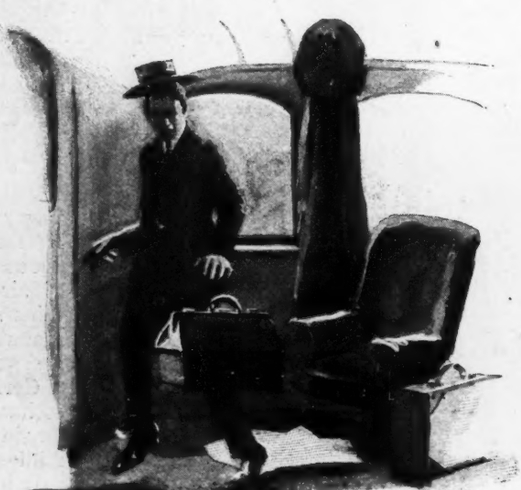


This boarding-house trick is a great muscle-developer; when she lowers her arm she will have before her a panful of fried eggs

Only Insulated Thieves Can Steal This Grip

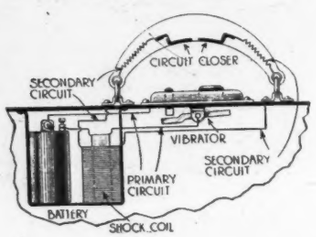
A MAN, who has entered the parlor-car from the other end, walks down the aisle in a businesslike manner, looking from one side to the other, as if he were trying to remember the location of his chair. He must be the owner of the prosperous-looking satchel in the vacant seat near the door, for he stops and takes hold of its handle. As he lifts the satchel, a smothered "Ouch!" escapes his lips. He drops the grip, and hurriedly leaves the car.

He was a thief. Why did he not carry out his intention? He had received a painful electric shock. An electric battery and "shock coil," stowed away in a little pocket inside the satchel, is connected with two metal strips on the inner side of the handle.



It was his intention casually to walk off with somebody else's satchel, but he received a shock

The two strips are separated by a non-conducting strip. When the hand is placed under the handle, the fingers, resting against the metal strips, act as conductors and form a bridge for the primary circuit of the electric current. A secondary circuit, causing the shock, is intermittently closed or broken by the up-and-down swinging motion of a balanced vibration lever when the bag is carried away.



Why Does Nature Do It?

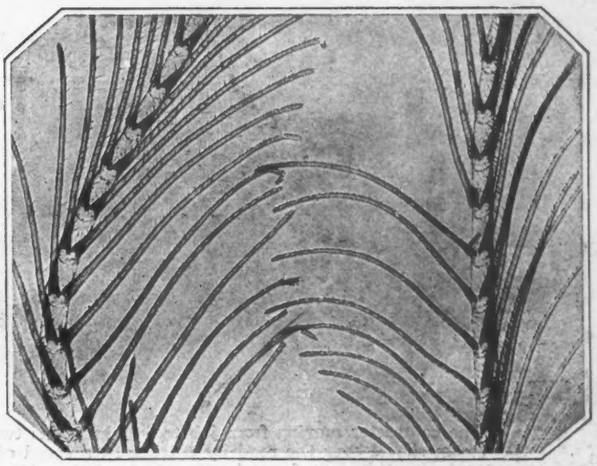
This two-headed turtle lives in the Chicago Academy of Sciences

DOUBLE-HEADED calves, Siamese twins, three-legged chickens—why is it that nature plays such pranks? No one knows exactly. Every living species, whether animal or plant, is unstable. The four-leaved clover and the white crow—just as remarkable, in their way, as the monstrosities of the circus side-show—prove it.

Darwin preached that new species are created partly by natural selection and partly by the age-long accumulation of acquired characteristics. But latter-day scientists have decided that new species are also created not only in this long, slow way, after millions of years, but suddenly. The chief exponent of this view is de Vries, who promulgated what is now called the "mutation theory," and which is accepted by many naturalists of our day.

A monk named Mendel, after experimenting with some sweet peas, developed a law of heredity which teaches us that these suddenly developed species or varieties are really permanent if they can be made to reproduce. The additional leg of a three-legged chicken, the extra head of a two-headed snake, the lack of color of a white crow—these are called "unit characteristics." A pair of double-headed snakes will have all double-headed offspring.

It so happens, however, that these freaks of nature are rather short-lived. When they do mate, it hardly ever happens that they mate with one of their own kind. But here, again, Mendel's law applies. Fifty per cent of the offspring will be hybrids of a very unstable kind, "throwing back" to one or the other of the parents in their offspring; twenty-five per cent will be pure-blooded like one parent, and twenty-five per cent pure-blooded like the other parent. This explains why, in a family, some of the children may be tall and some short.



The beautiful antennae of insects are now thought to possess a sense uncomprehended by human beings

Such monstrosities as this three-legged chicken can be artificially produced. Biologists have whirled eggs in centrifugal machines before hatching with very curious results

This two-headed snake is also in the Chicago Academy of Sciences. The whole science of "teratology" has been built up in an effort to explain those couplings in the animal world that give rise to double-headed and double-bodied forms

Have Insects' Antennae Some Unknown Sense?

IT is the general consensus of opinion among entomologists that the antennae of insects smell as well as hear. Those of us who have studied these wonderful organisms are inclined to think that they contain some sense, or at any rate a sense modification, that human beings cannot comprehend, because they possess no faculty that exactly corresponds to it. There is a modification of the sense of smell that does not seem to be only that sense as we know it, because insects are attracted before it would seem possible for the odoriferous particles to be carried to the distant insect.

Recently a naturalist made an observation. He was in the woods one day, when his nose began to bleed. Within a minute after the blood had fallen on the leaves, the flesh-flies appeared. Yet it was a perfectly still day. In such cases it does not seem possible that the flies could have been influenced by smell as we ordinarily understand it.

An astonishing fact is that the antennae of various insects show so many different forms. These, however, have long been the delight of the microscopist.

How a Snake Wriggles into the World

THE National Zoo in London announces the arrival of three newborn ring-necked snakes—all doing well.

Of course, there isn't anything very unusual about the birth of a snake, but these three little ones were caught by the camera man in the act of coming into the world. The photograph is shown herewith.

As will be seen, the oldest of the triplets has entirely cast off its shell and is raising its head in order to take a good look at its surroundings.

The other two have just started to emerge from their shell; but no odds have been offered as to which one will get out first.

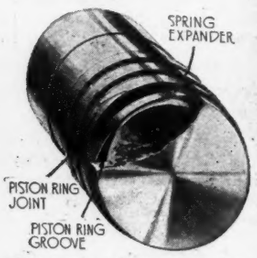
These snakes are called ring-necked because of a pale yellow marking in the form of a ring that appears around their necks. They belong to the harmless Colubrine family, which is found mostly in Great Britain.

Caught in the very act of being born, these ring-necked snakes are racing to see which one will get out first

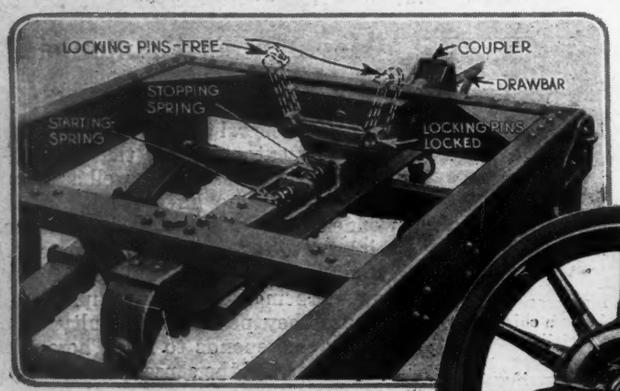
Give a Thought to

These new ideas and accessories will

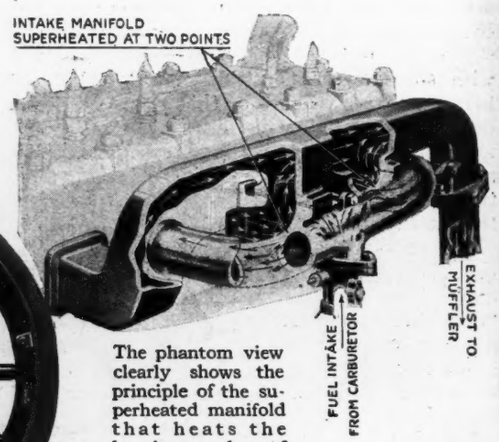
The contractor moving from job to job hauls his twenty-two-ton steam shovel over the road by a truck at a speed of eight miles an hour; this was formerly the work of five teams of horses



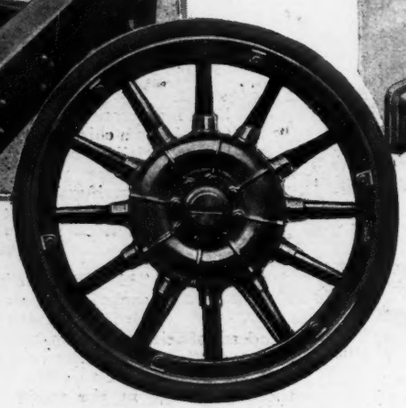
When the piston rings become loose the compression in the cylinders is lost. This spring expander is inserted in the groove in back of the ring to keep it tight



A new trailer drawbar is characterized by two simple locking pins. Two sets of coil springs take up the starting and stopping strains

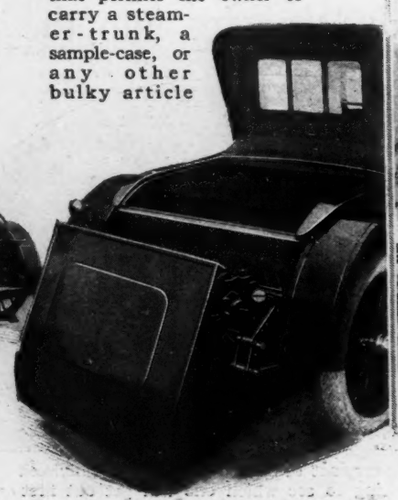


The phantom view clearly shows the principle of the superheated manifold that heats the heavier grades of fuel so that they vaporize readily



In this new type of wheel all shocks are taken up by the hub. The wheel is puncture-proof and protected by steel plates

Here is a good idea for the tractor dealer who wishes to advertise the tractor he is selling. This particular tractor moved a circus when its horses were mired

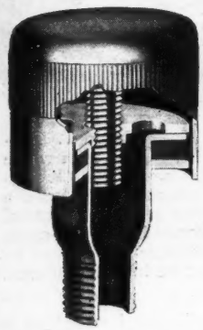


On the rear deck of a new roadster is a removable cover that permits the owner to carry a steamer-trunk, a sample-case, or any other bulky article

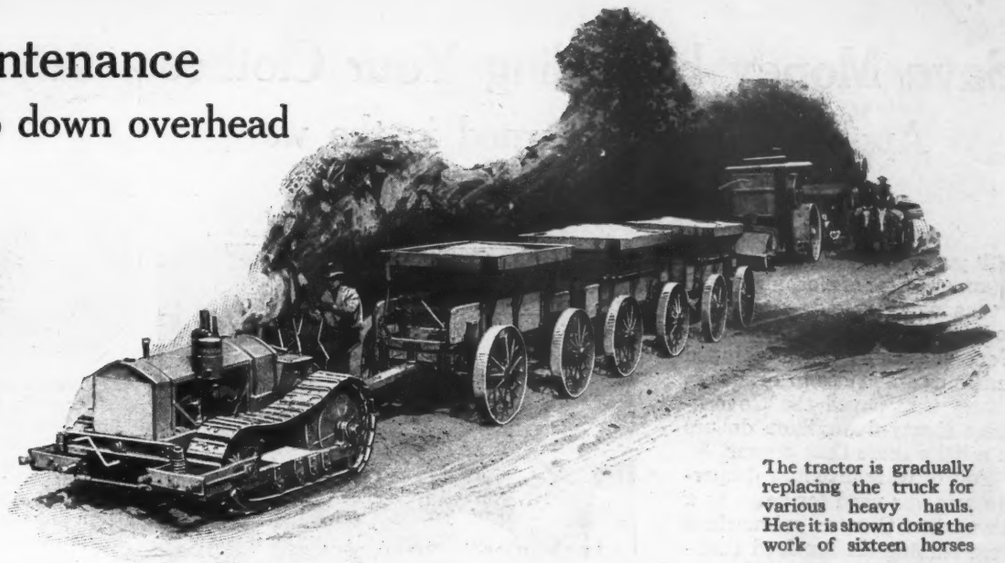
It is said that this thirty-ton section of a Pacific Coast giant is the largest single log ever hauled by a motor-truck and trailer

Motor Maintenance

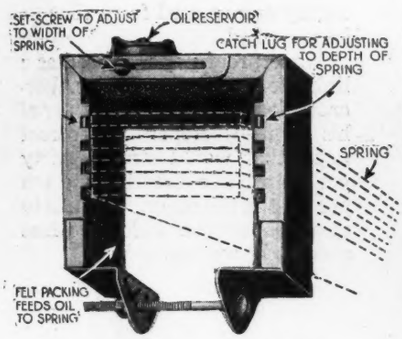
help you keep down overhead



The center-thread grease-cup makes filling more easy, and assures a certain and quick job of screwing down its cover without the annoying fault of crossed threads



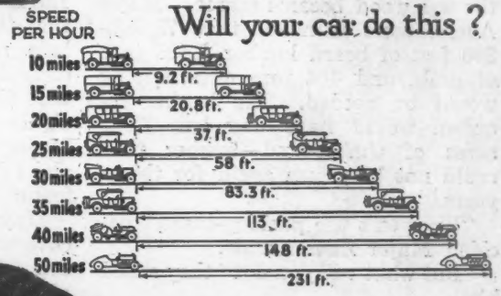
The tractor is gradually replacing the truck for various heavy hauls. Here it is shown doing the work of sixteen horses


SET-SCREW TO ADJUST TO WIDTH OF SPRING
OIL RESERVOIR
CATCH LUG FOR ADJUSTING TO DEPTH OF SPRING
SPRING
FELT PACKING FEEDS OIL TO SPRING

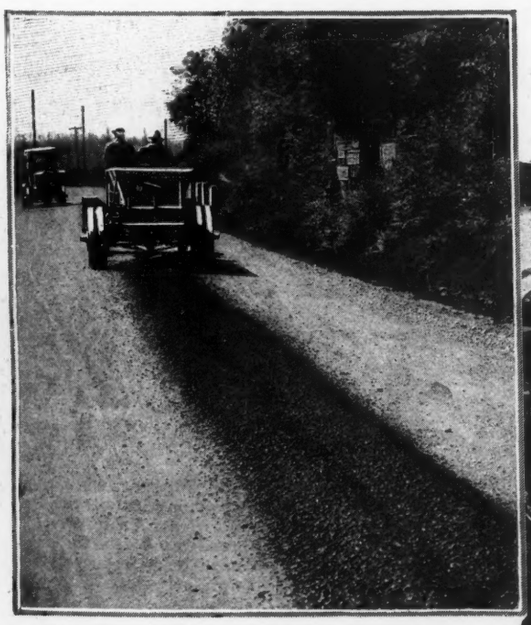
Here is a spring oiler that is very simple in construction, and which may be fitted upon all sizes of motor-vehicle springs. The oil is poured into a reservoir in its top

In a factory at Melbourne, Australia, an explosion sent an automobile tire hurtling through a hardwood floor. The tire was found to be uninjured

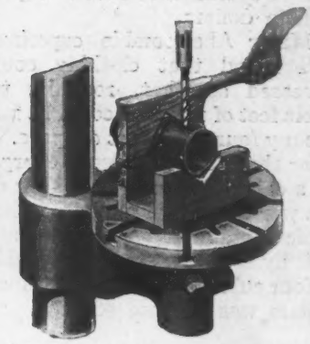
Pistol grip and trigger switch allow the valve-grinder to be operated after the manner of an automatic gun. Bits are provided to make it adaptable to various valves



A chart showing in what distances cars ought to be able to stop if their brakes are in good condition



This truck spreads gravel thinly upon the road, so that it in no way interferes with traffic and does not require men for further spreading. It travels at ten miles an hour



A wood block stand for holding pistons that need drilling can be inexpensively made

Save Money by Baling Your Clothes

Apply this lesson learned in the war

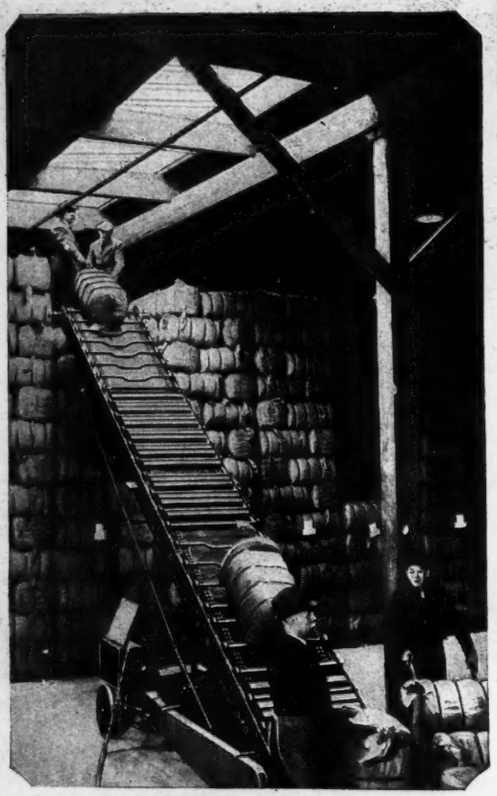
By Michael Connors

Introducing Major David T. Abercrombie, Q. M. C., the man whose baling process saved the Government eighty-five million dollars in a little over a year's time. Instead of shipping uniforms in packing-cases, Major Abercrombie baled them by a process that he invented himself

IF you are a manufacturer or an exporter of clothing, it will mean dollars and cents to you to learn how the Quartermaster-General's Department shipped uniforms and shoes to France in a way that saved the Government eighty-five million dollars in a little more than a year.

Few of us realize how desperate was our need for ships at a time when German submarines were sinking six hundred thousand tons a month. "Give us ships, ships, and more ships," was the demand of those who had to equip and feed our Army in France.

In the autumn and winter of 1917-1918 it became apparent that if the war was to last very much longer there would not be shipping space enough to carry the equipment and supplies required by the forces that we intended to send overseas. New methods of shipping equipment had to be invented, and the man who invented them was Major David T. Abercrombie, of New York.



We sent uniforms to France, not in packing-cases, but in bales. The outer burlap was used for the making of two million sand-bags

Compressing Twenty Cubic Feet into Four

Clothing is usually shipped in wooden packing-cases. But during the war wood became scarce. Major Abercrombie estimated that 72,762,300 feet of board lumber, 2,425 tons of nails, and 404 tons of strapping would be needed. The lumber required would have denuded 7,552 acres of timber-land—lumber that could not be grown again for thirty years.

"We won't use packing-cases," decided Major Abercrombie.

"But what will you do?" they asked him.

"Bale everything," was the answer.

And that is how it came about that the Government saved eighty-five million dollars.

Major Abercrombie experimented, and found that clothing could be squeezed so that, roughly, twenty cubic feet of material could be made to occupy four cubic feet of space. Consider that ship tonnage is charged for on a cubic foot basis, and that during the war the rate was eight dollars per cubic foot, and you can see at once that by compressing twenty cubic feet to four cubic feet a saving of ninety-six dollars was at once effected. Then consider that during the war 1,371,000 bales were shipped, that the net saving on each bale ranged from fifty to sixty dollars, and you can see that the Government saved eighty-five million dollars. Major Abercrombie's project also released 8,180,000 cubic feet of shipping space.

Major Abercrombie discovered that proper baling depends on the proper folding of a uniform. Baling should crease a uniform along the right lines.

Folding the Garments Scientifically

To carry out Major Abercrombie's process, the garment is first carefully folded to a form. A given number of folded garments are then packed in a brick container, corded together so that the bricks cannot fall apart. The folded uniforms in their brick container are then placed in a machine.

First of all, hand pressure is applied to form a fairly compact bale. But that bale is not compact enough for Major Abercrombie. It is subjected to the additional squeezing effect of a power baler until it assumes the highly compressed form that he has in mind.

Waterproof paper is used as a lining for each bale. Major Abercrombie had to invent a paper of his own—a creped waterproof paper that would stretch thirty per cent in one direction and ten per cent in the other. Thanks to that paper the bale becomes absolutely waterproof.

In order to save shipping space when the submarine was doing its worst, the Quartermaster-General shipped army shoes abroad in bales, the space they occupied being reduced by about thirty-four per cent. Why not use this system in time of peace?

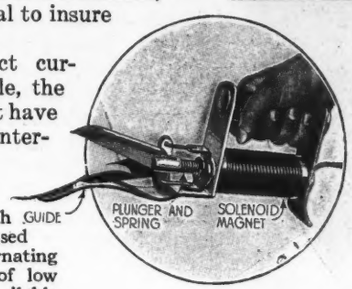
Electromagnetic Scissors for Cutting Cloth

TAILORS, dressmakers, and others whose business compels them to use shears or scissors frequently, may save themselves a great deal of unnecessary waste in strength and energy by employing mechanical scissors operated by electricity, air-pressure, or some other force.

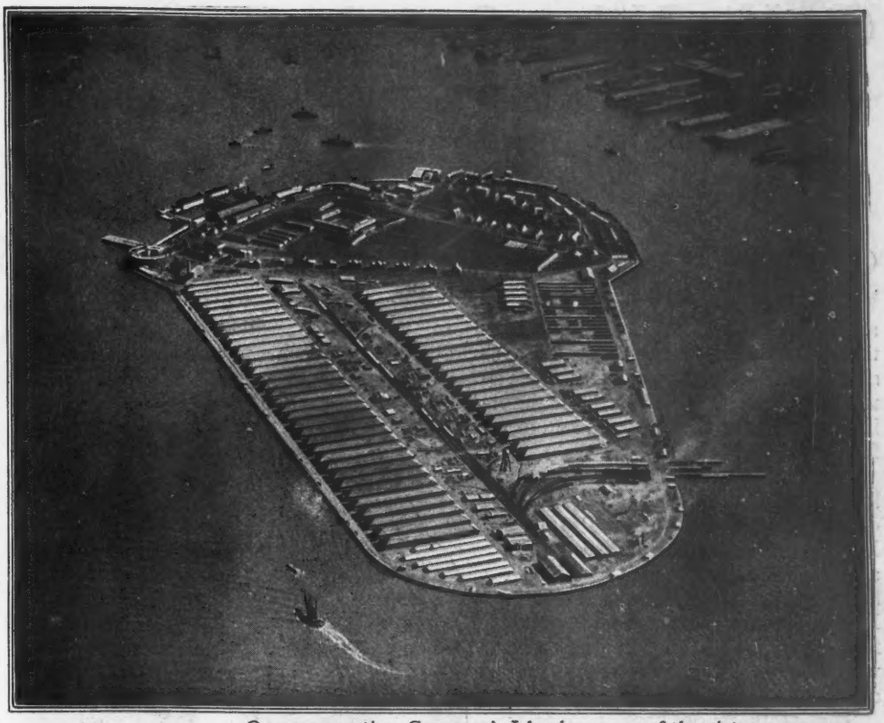
The current, acting upon a solenoid, causes the plunger within the coil to move toward the closed end of the tube, away from the cutting end and against the pressure of a coiled spring, which asserts itself whenever the electromagnetic power of the solenoid ceases to act. The alternating forward and backward motion of the plunger causes the scissors to open and close.

The solenoid tube, with the cutter attached, has a handle by which it is guided by the operator. A flexible tongue, extending beyond the points of the scissors, lifts the material to insure a smooth cut.

If only direct current is available, the apparatus must have an automatic interrupter.



This recent French invention can be used wherever an alternating electric current of low frequency is available



Once upon a time Governor's Island was one of the picturesque features of New York's upper harbor. Now, though it has lost most of its artistic charm, it is infinitely more useful

What the War Did to Governor's Island

NEARLY everybody who lives in the vicinity of New York knows Governor's Island; yet it will probably not be recognizable in the view shown above, which was photographed from an airplane flying over the harbor at a height of eight thousand feet.

Governor's Island did not always look like this. Not more than twenty-five years ago the island was only one third of its present size. It included only the irregularly shaped part at the north end of the present island, easily distinguished in the picture from the new filled-in part with its painfully regular outline.

During the war Governor's Island became an important base for the distribution of military stores. On the filled-in part, which comprises fully two thirds of the island, fifty-four warehouses were erected in two parallel rows. In the aisle between the two rows a railroad line was built, with a Y to the loading and unloading pier near the southern end of the island.

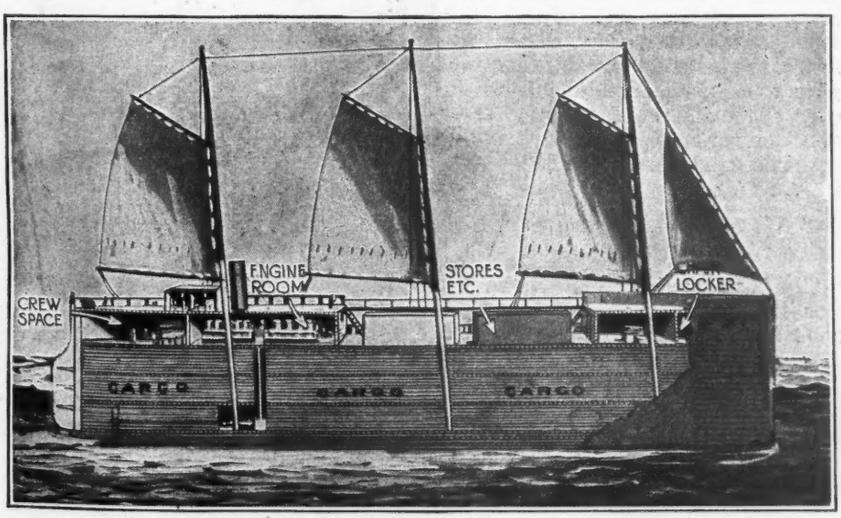
Comparatively few changes were made in the original, old part of the island. On this part are the ancient citadel used as a military prison, the star-shaped fort, the barracks for the soldiers of the garrison, the comfortable officers' quarters, the various office buildings of the Department of the East, and the parade grounds.

The landing-places for the ferry lines that connect Governor's Island with Manhattan and Brooklyn are located in the northern part of the island, facing the mouth of the East River. Cables containing telegraph and telephone wires put the important military offices on the island in direct touch with the outside world.

The Cargo Is the Ship

SHIP, cargo; cargo, ship: remove the ship and let the cargo serve as both. So said the owners of five million feet of timber which they wished to send from British Columbia to England.

The timber was sawn so that it measured twelve inches square in cross-section. The floor of the ship consists of six alternate layers. The sides are flat and the bow and stern wedge-shaped. The ship is held together by steel screw-bolts. When she reaches England the bolts will be taken out and the lumber used. Besides sails, the ship is equipped with heavy-oil engines.



Near the engine-room are the chart-room, the captain's quarters, and crew space; under the forecastle deck are the stores and chain locker

Can You Make a Crate that Won't Break?

Some results of the Forest Products Laboratory's experiments in the testing of boxes, barrels, and crates

By Lloyd E. Darling

SHIPPERS have, within recent years, rather been forced to the conclusion that there is a science and art in the building of shipping containers. Before the war this conclusion was thrust upon them by the mishaps that befell them in attempting to reach South American and other foreign trade.

But during the war the idea crystallized. It culminated in special activity on the part of the Forest Products Laboratory at Madison, Wisconsin—a branch establishment of the United States Department of Agriculture. Here a school was brought into being for the training of men having to do with the packing and crating of quantities of material sent overseas.

The tests made here, primarily instituted to promote war efficiency, have provided a fund of information that will be invaluable to manufacturers and shippers in peace time. The shipping departments of the larger manufacturers have already made tests and experiments of their own. In fact, every package sent out is an experiment. But the subject is still dark and uncertain in a great many of its aspects. So we pass along the results of the Forest Products Laboratory's experience because of their special value in contributing to the general fund of knowledge on the subject.

What methods are followed in this packing-box testing laboratory? We may preface an explanation by quoting D. L. Quinn, in charge of the Madison Laboratory's work:

"A properly designed packing-box is one which has enough strength in each part for the purpose for which it is intended. More than this, it should have no more strength in any part than is necessary to balance the average strength in every other part. The data necessary for designing such a box cannot be obtained from observation of boxes in actual commercial service, because the observer sees the box only after it has completely failed. He does not see the beginning of the failures; and he does not see, and consequently cannot measure, the hazard which completes them.

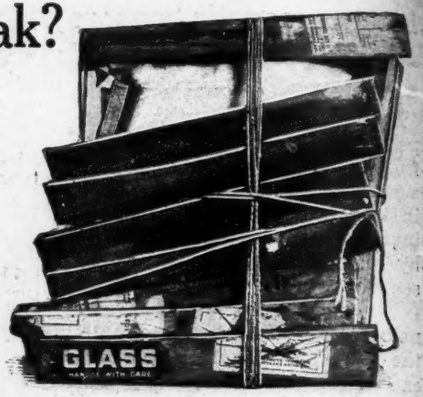
"A failure frequently bears evidence in itself of the cause of the damage. There is, however, no way of determining from a study of the failure the amount of force exerted by the damaging cause. In cases where several causes have been active, it is impossible to identify each of them."

He concludes, therefore, that the immediate task of a testing laboratory is to go at one thing at a time. That is, the tests applied to containers should be of such a nature that defects will be shown up singly, and under such conditions that the stress applied, and also the results, may be carefully checked up and kept track of. By thus measuring defects individually and "pooling" the results, so to speak, the tester will be able to gain a comprehensive knowledge of the all-around strength of the box or crate, and its probable capabilities when in actual service.

Up and down it goes! The block-and-tackle machine finds out whether a box will stand falls

Initiating Tests

The "compression along an edge" is one of the tests applied. This consists in standing a box upon one edge and applying a steady and constantly increasing pressure to the diagonally opposite edge. The longer the box holds out against such a squeeze, the better box it is. Another box of the same kind will be stood up on one corner, and then pressure applied to the opposite uppermost corner. The longer the box holds out against this test, the better box it is. The illustration at the bottom of this page shows details of the process.



What happens to a box after the freight-handlers have given it their attention. The Forest Products Laboratory hopes to prevent this

Another test applied to boxes in a laboratory is to drop them. Simple, isn't it? Even a youngster applies that principle. If Amy Brown has a doll with a china head, and she deliberately drops the doll on a cement sidewalk, and the head doesn't break—why, naturally, the doll is a better one than Dorothy Smith's, which does break under such conditions. Simple as A B C.

So in the laboratory they drop boxes. They haul them up off a solid floor with a block and tackle, and then let them come violently down again. They let them come down on an edge, then on a corner, on an end, on a side—every way. If the box

Squeezing a box cornerwise to find out how much persecution it will endure before giving in. Good boxes stand a great deal of this

stands up under all that, it is a good box and can be depended upon to stand up under actual service; because such man-handling as this is what the box actually gets from the freight rustlers and dock employees. The testers reason that it is better to find out in a laboratory whether a given kind of box is no good for its purpose than to find out on the road, and perhaps lose valuable goods in the process. That this is sound reasoning, is evident.

The Revolving Drum

A particularly choice number in the repertoire of the testing men is to run a box through the revolving drum apparatus. This looks a good deal like a concrete-mixer, only its drum is larger. A box is put inside the drum, then the drum proceeds to go round and round in regular concrete-mixer fashion. Meanwhile the box is bumping around among all kinds of pillars and posts inside. When it comes through this test—if it does come through—it is initiated indeed.

The drum revolves so slowly that, as the box drops from one projection to the next, the beginning of breaks and cracks can be noted. The weak points in the construction of the box will, of course, readily make themselves apparent, and in the next box made along this line, the construction can be altered in such a way as to avoid defects of the kind that the test brought out. By continually building and testing in this way, boxes are ultimately developed that are equally strong in all features. Like the "one-hoss shay," they will go to pieces all at once, if they go to pieces at all. Their failure will not be because of single defects, such as nails pulled through soft wood, or because ends of boards split or broke off, or because the wrong lumber was used for that particular box in the first place. The box constructor will *know* what he is doing.

Round and round goes the box in the "concrete-mixer machine," receiving bump after bump. If the box has any hidden defect it is sure to be revealed during the process

The laboratory has found that the length of a nail, rather than its gage, seems to be the principal factor in its holding power. Since nails split wood, it has been found that it is desirable that as small gage nail be used as can be driven by a nailing-machine. Mr. Quinn finds that standard cement-coated box nails seem to be most desirable from the standpoint of both efficiency and economy.

"Nails," says Mr. Quinn, "should be driven flush with the wood. They should never be over-driven. Over-driving causes the heads to break the fiber of the wood under them, often to such an extent that no holding power is left in the wood. The first strain on the box then causes the wood to pull away from the nails. The evil effect of over-driving nails naturally increases as the material in the boards is made thinner. But *in any box* over-driving is bad practice, and should be guarded against.

"The size of the nail to be used depends upon the species and the thickness of the lumber in which the points of the nails are held. With the woods white elm, red gum, sycamore, pumpkin ash, black ash, black gum, tupelo, and soft or silver maple, as well as hard maple, beech, oak, hackberry, birch, rock elm, and white ash, the penny of the nail should be the same as the thickness of the lumber expressed in eighths of an inch. The following woods take the next penny larger: white pine, Norway pine, aspen, spruce, Southern and Western yellow pine, cottonwood, yellow poplar, balsam fir, chestnut, sugar pine, basswood, cypress, willow, noble fir, magnolia, buckeye, white fir, cedar, redwood, butternut, cucumber, alpine fir, lodgepole pine, hemlock, Virginia and Carolina pine, Douglas fir, and larch.

"Sixpenny nails and smaller should be spaced not more than two inches apart when driven in the side grain of the end, and not more than one and three fourths inches apart when driven in the end grain. The spacing of nails in end construction should be increased from the above, one fourth inch for each penny over six."

More Facts About Nails

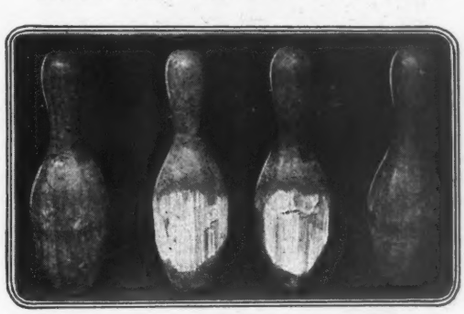
One hardly realizes the force it takes to pull a nail out of a wooden board. In experimenting with the holding power of cement-coated, plain, and barbed sevenpenny nails, driven one inch into dry wood, Mr. Quinn obtained the following facts:

Using a cement-coated nail, it takes about a 225-pound pull to get a nail out of one inch of longleaf yellow pine, 133 pounds out of basswood, and 430 pounds out of beech. Plain nails took 140 pounds with longleaf pine, 82 pounds with basswood, and 400 pounds with beech. Barbed nails required only 110 pounds with longleaf pine, 70 pounds with basswood, and 335 pounds with beech.

Effect of Wet Lumber and Storage

The following chart, based on the Forest Products Laboratory's investigations, shows how the strength of a box is altered by moisture and by neglect in general. Keep your boxes dry, but not bone-dry.

	Strength Relation Per cent
Nailed and tested at once at 15 per cent moisture	100
Nailed and tested at once at 30 per cent moisture	90
Nailed at 15 per cent, tested at 5 per cent moisture, 4 montns' storage	75
Nailed and tested at once at 5 per cent moisture	50
Nailed at 30 per cent moisture, tested at 5 per cent moisture, one year in storage	15
Nailed at 5 per cent moisture, tested at 35 per cent moisture, stored 2 weeks in exhaust steam	10



These blocks of wood have been through a stretching-machine to see how much tensile strength they have. The cracks show where the wood broke

Who Won Our

In these pages are set forth ideas contributed to the

WHEN you glance at the illustrations below we are sure you will proved, beyond a doubt, that the humble hairpin, in an emer- letters from all parts of the world, and many and various were the of the ideas, but for their practicability.

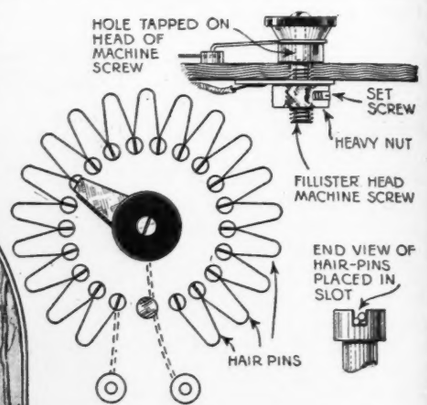
The hairpin now assumes a new dignity; for it not only has afield. Fish-hook, gun-cleaner, finger-splint, scrubbing-brush, only a few of the best. All hail to the humble tress-binder of

We wish to thank the contributors, and offer the non-winners Prize Contest announced on page 124 of this issue: "What Can Be

If you run out of test-tube holders, curve one end of a hairpin and secure the other to a cork.—*William Wylam*

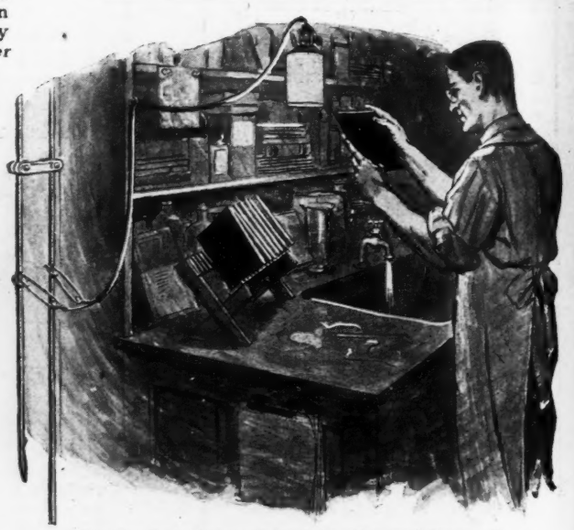
The hairpin is pushed through the cork, and the projecting ends bent into the cork again, forming an emergency handle to remove the cork from the bottle with perfect ease.—*C. F. Gimm*

Holes are drilled into a wooden block, the hairpins thrust through, and another block with a handle placed over them. This forms an unusually strong and handy scrubbing-brush.—*F. Spangler*


HOLE TAPPED ON HEAD OF MACHINE SCREW
SET SCREW
HEAVY NUT
FILLISTER HEAD MACHINE SCREW
END VIEW OF HAIR-PINS PLACED IN SLOT
HAIR PINS

The first prize winner is *Francis R. Pray*. He says; "The common wire hairpin makes an admirable resistance unit. As the hairpins are all machined to the same length, each one has a resistance which varies with its particular size. When mounted in between the contact points of a rotary switch, a rheostat, variable in uniform steps, results. Such a contrivance is reliable, and easy to assemble"

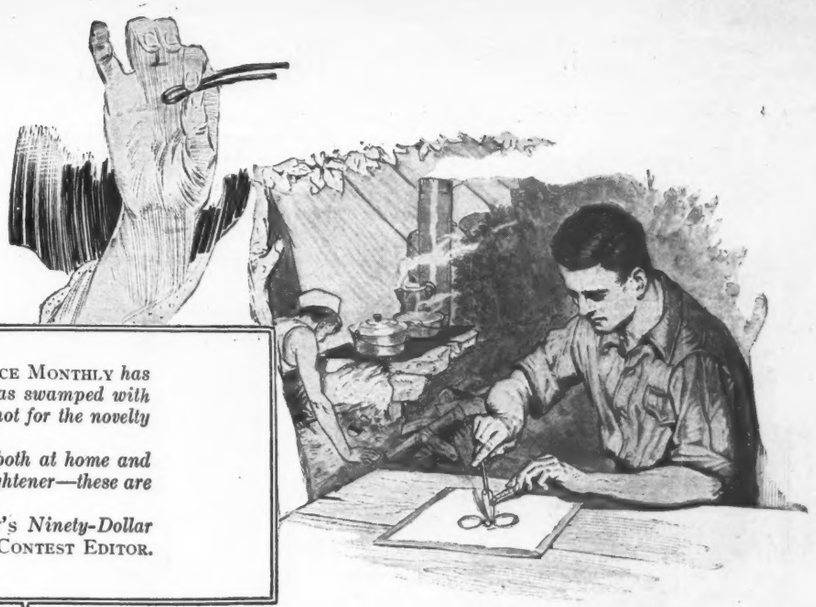
Hairpins can be wound on a piece of drill-rod to substitute for stripped threads. Needless to say, they work to perfection.—*James McIntyre*



Here the hairpins are bent into clips and fastened to ends of wires that run to a lamp. They form an emergency connection.—*Otto Kirby*

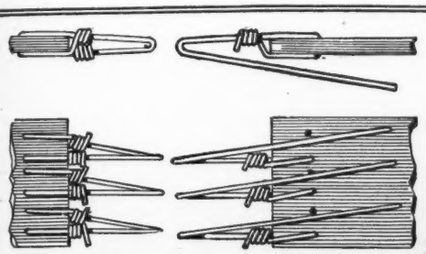
Hairpin Contest

a few of the avalanche of Popular Science Monthly

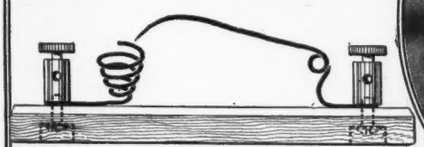


never despise the hairpin again. POPULAR SCIENCE MONTHLY *has gency, is without a peer. The Contest Editor was swamped with uses suggested. The judges awarded the prizes, not for the novelty*

saved human lives, but it has rendered first aid both at home and bottle-opener, rheostat, belt-splicer, stub-nose straightener—these are woman.
another chance in POPULAR SCIENCE MONTHLY'S *Ninety-Dollar Done With the Exhaust of a Gasoline Engine?"*—CONTEST EDITOR.



Clifford A. Butterworth won the second prize with a hairpin repair for a broken automobile fan belt. Heavy wire hairpins were put in place of the old lacing, and bent as shown, so that they could be hooked together



PARTS MOUNTED ON BASE

John A. Weaver won the third prize with a hairpin detector. It is known as the cat-whisker type, and, strange as it may seem, it will be found just as efficient as the most elaborate and expensive instrument made. Many wireless operators have tried this

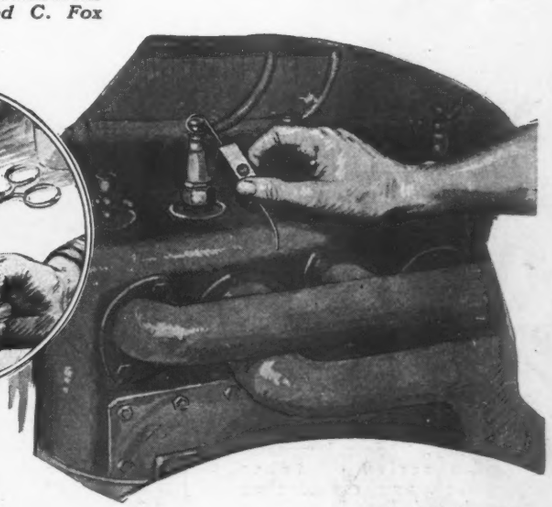
Having the misfortune to break the nose-piece of my glasses, I soldered a hairpin to their frame. This made an excellent though unusual nose-piece.—*W. C. Scully*

Baby Katherine soon became quite content with this unusual treatment, and after eleven months of wearing the hairpin was cured of her ugly stub-nose.—*Alfred C. Fox*

Twist up some match-sticks in a hairpin, remove them, and substitute brush bristles taken from an old brush, then twist the whole together tightly, and you have an efficient cleaner for your gun.—*Lawrence Halsey*

Recently a patient came to me with a broken index finger. Unfortunately I had no splints. Some large hairpins around the office suggested a novel splint which I put into effect with excellent results.—*Dr. John N. Lawrence*

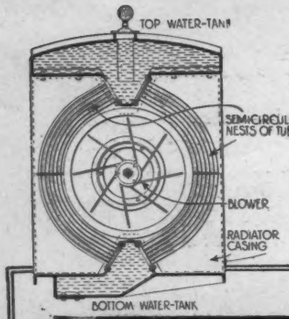
I took the hairpin, wrapped a little adhesive plaster around the wide end, brought it together, and made a sanitary splint. The finger fitted the hairpin snugly and it was in no way uncomfortable



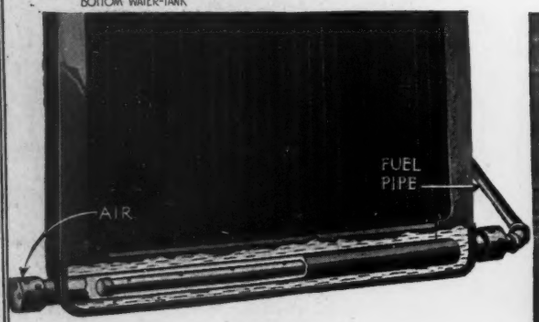
Here is a spark-plug tester made from hairpins and a small wood block. The ends are grounded on the block and engine block, and a spark jumps the gap made for the purpose. Thus your spark-plug is tested.—*Anthony F. Schoch*

The Latest Fashions in Radiators

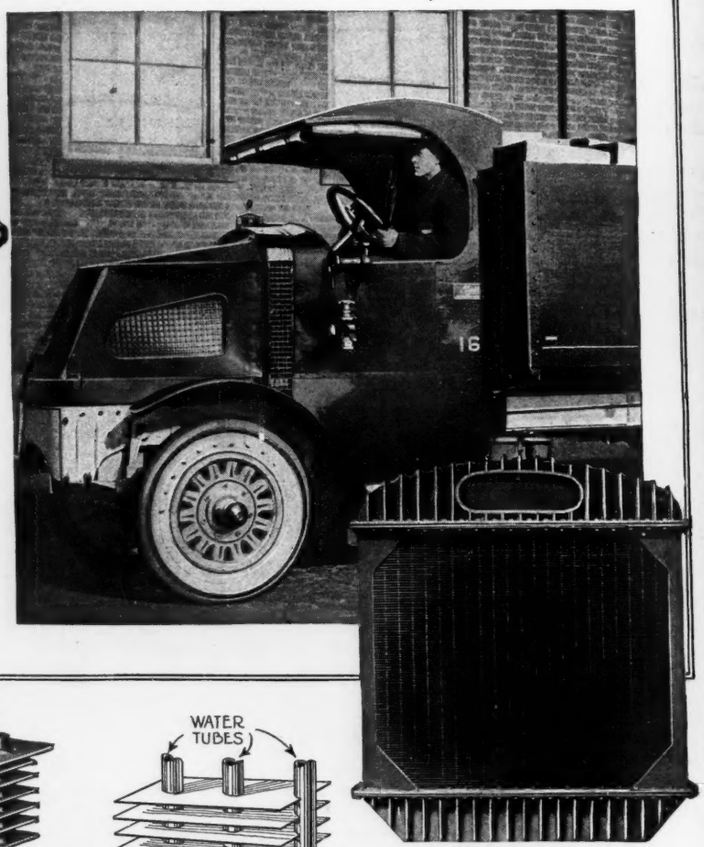
Different makes have different



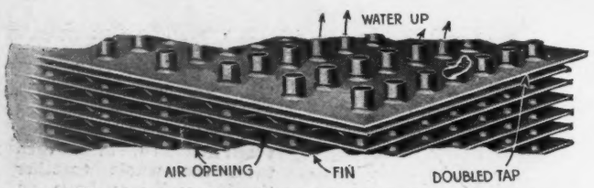
The ring type circular radiator is peculiar to one or two makes of trucks. It is set in back of the engine instead of in front, and the blower fan is inside the nest of tubes



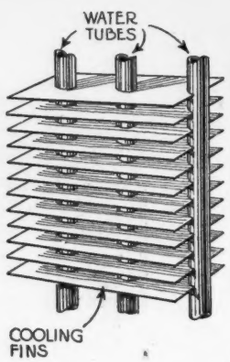
A novel feature of this radiator includes a tube that is filled with kerosene and lighted to keep the water from freezing in winter



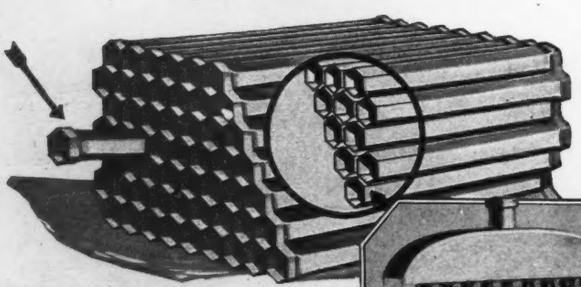
Here is the truck with the circular radiator mounted upon it, a sketch of it being shown in the upper left-hand corner of this page. Removable shields shut out excess air in winter



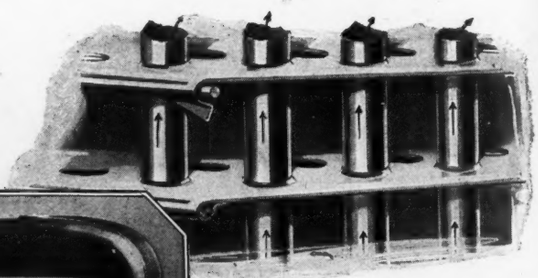
The two essential units in the continuous fin tubular type of core are vertical water-tubes and horizontal cooling fins or plates. This allows a large volume of air to circulate throughout the system



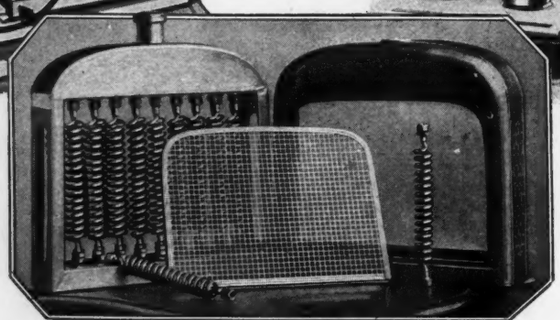
Ease of repairing is one advantage of the continuous fin tubular type; another is its unusual rigidity and the core construction, which makes possible a quick and unimpeded exhaustion of heated air



The honeycomb type is nothing more than a combination of hexagonal or other shaped openings, with the metal so thin that the heat is radiated quickly. The core is made up of a series of tubes which are expanded at each end, leaving narrow spaces between the tubes



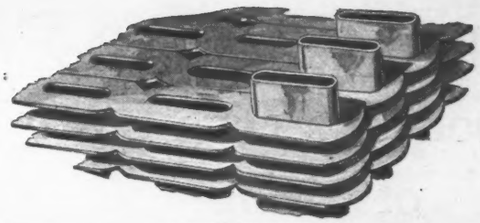
Then there is the plain tube type, with the tubes cylindrical in shape. One of these is shown above. The tubes are placed vertically, and tied together in every direction by the horizontal plates, which are re-inforced with steel wire at the front and rear edges



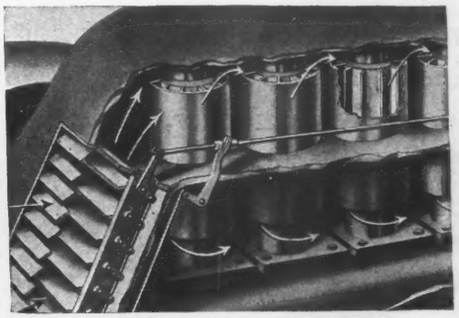
A seldom used type is this one composed of spiral tubes. A wire screen placed in front of the radiator protects it from accidental injury

for Trucks and Automobiles

types of cooling systems

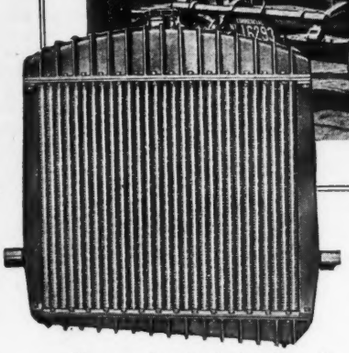


The flattened or deformed oval type of tube, in which the tubes are arranged one behind the other

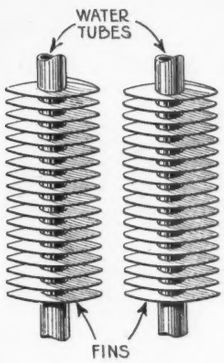


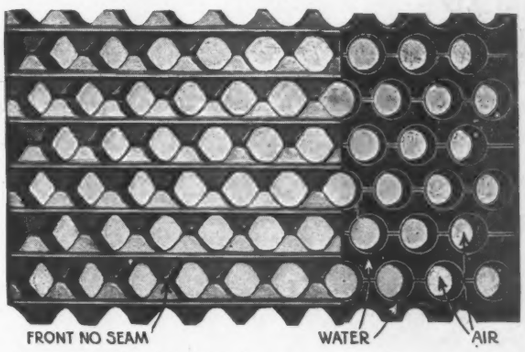
The air-cooled engine works efficiently without the aid of water and other cooling apparatus, such as radiator, hose connections, piping, pump, and water connections. The air is drawn down and around through the engine by the flywheel fan

In the type shown at the left, the finned tubes are arranged horizontally instead of vertically, as is usual in the average truck

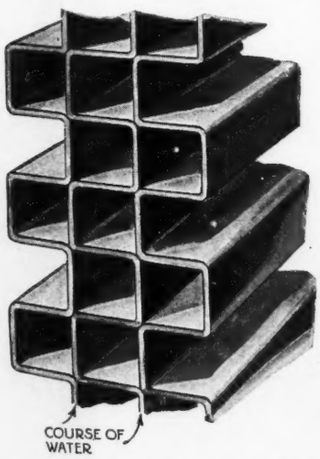


The seamless helical tube radiator is a result of long expert study in radiator design. It is fitted with spiral fins on each tube, as shown at the right

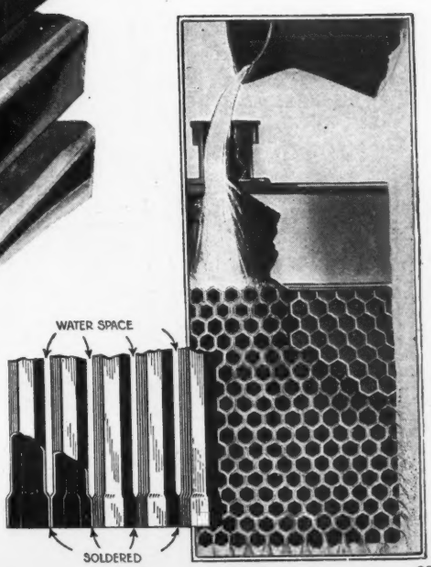




The modified honeycomb type is made up by taking one piece of metal and bending it back in the center. The two ends are then brought to a straight edge, lapped, and set together under pressure, eliminating one joint in the tube

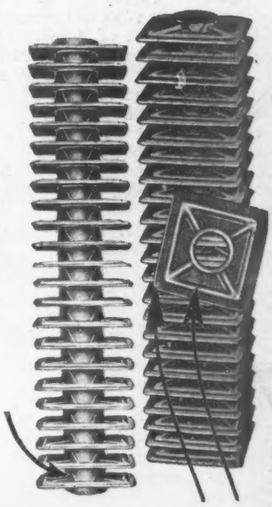


In this type the zigzag tubes are set together to form a part of the radiator, the tubes being of the pressed metal shape. The arrows show the course of the water in its downward flow. Note the large cooling areas



Here is a cut-away view of the honeycomb type. The water, poured into it, flows from the upper tank down through the thin compartments to the lower tank

In the true round type of tube, set vertically, some of the designs are furnished with fins which are attached individually to each tube by means of shoulders that fit solidly against the tube



What Can We Do About the High Cost of Living?

In which we attempt to set forth in pictures why we are chasing dollars more madly than ever, why the dollar is fleeter than we are and why we have got to increase our speed

Here is the Modern Donkey. All he sees are those dollars ahead of him. He wants more dollars; but the harder he runs to catch up with them, the faster they recede from his grasp. If you put by a dollar in 1896, by the year 1909 it was worth in goods about two thirds of its original value. Today all that remains of it is rather less than one third. Those who have suffered most by the increased cost of living are office employees and members of the professions. They are ground between the nether millstone of capital and the upper millstone of labor. This situation has become so acute that professional men, physicians, chemists, etc., are throwing to the winds all tradition and precedent and are forming unions in order that they may bargain collectively for a large income

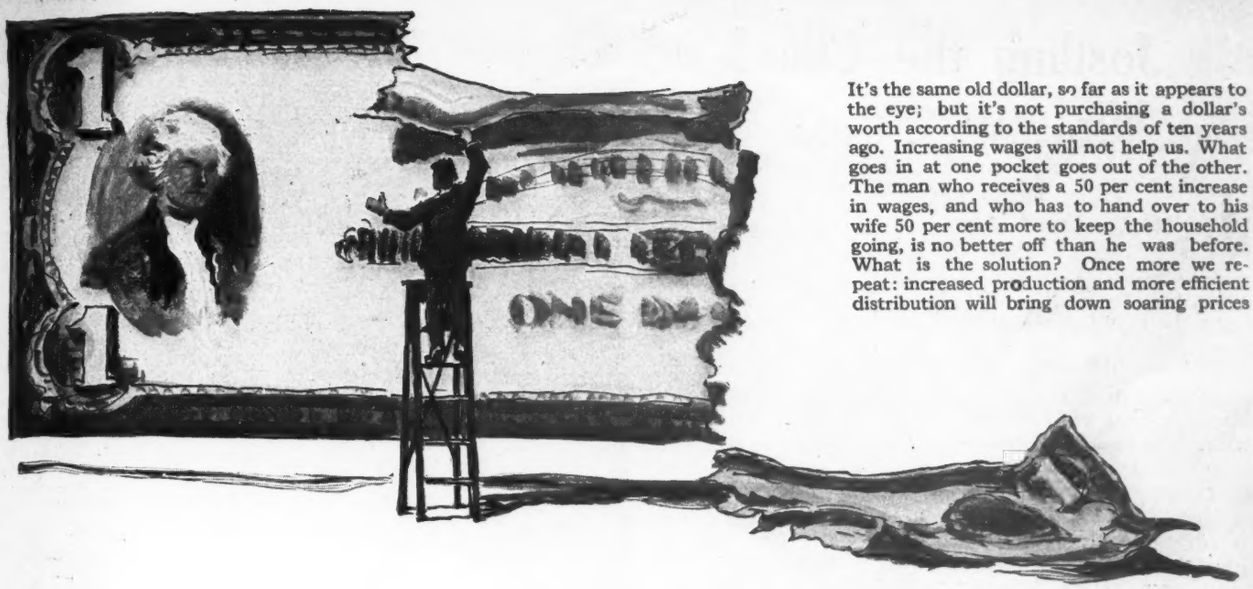
IN addressing Congress on the cost of living, President Wilson said:

"With the increase in the prices of the necessaries of life come demands for increase in wages—demands which are justified if there be no other means of enabling men to live. Upon the increase in wages there follows close an increase in the price of the products whose producers have been accorded the increase. . . . The laborers who do not get an increase in pay when they demand it are likely to strike, and the strike only makes matters worse. It checks production, it affects the railways, it prevents distribution and stops the markets, so that there is presently nothing to buy, and there is another excessive addition to the crisis resulting from the scarcity."

According to a statement recently issued by the National Industrial Conference Board of Boston, the cost of living for American wage-earners was 71 per cent higher in July, 1919, than at the beginning of the World War in July, 1914. This is an increase of 6 per cent since March, 1919, and of 12 per cent since July, 1918. Since the beginning of the war, food has increased in cost 89 per cent; shelter, 28 per cent; clothing, 100 per cent; fuel, heat, and light, 57 per cent.

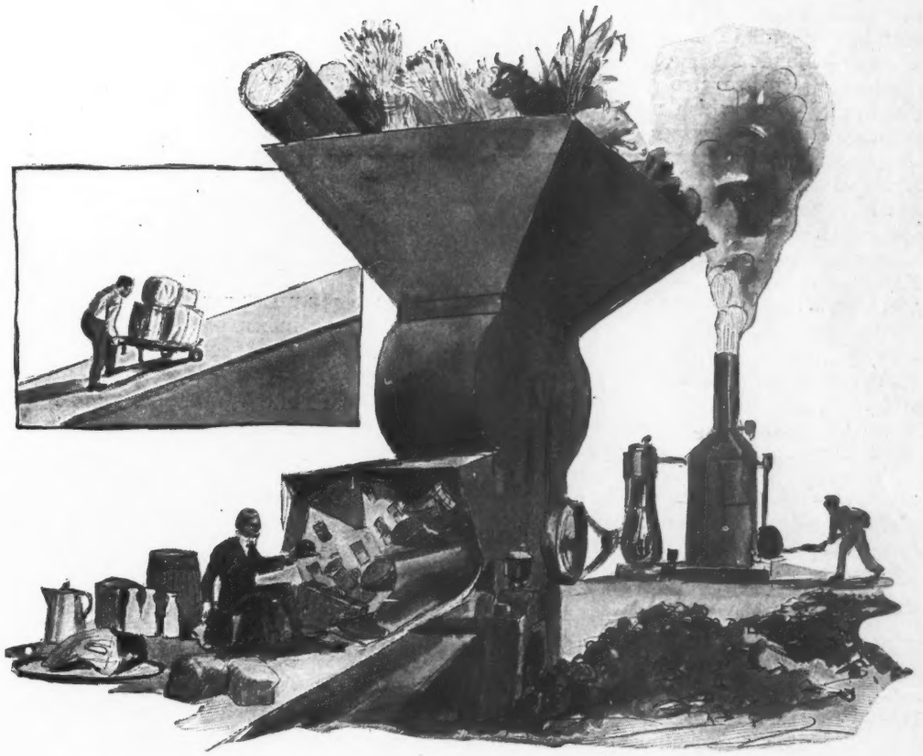
What is the remedy? Economists are agreed that there must be an increase in production and more efficient distribution.

We are all in a treadmill. There's no use in agitating for higher wages. Just as soon as we step up one rung in the scale of wages, we increase the cost of living. It is not more dollars that we need, but greater efficiency, so that we may produce more with the same or less effort. It is not what the dollar will buy that counts, but what the day's wage will purchase. No money on earth can buy goods that do not exist. High wages will not help if production falls short. Therefore, produce. Whatever you can do to increase efficiency tends to increase the amount that your wages can buy



It's the same old dollar, so far as it appears to the eye; but it's not purchasing a dollar's worth according to the standards of ten years ago. Increasing wages will not help us. What goes in at one pocket goes out of the other. The man who receives a 50 per cent increase in wages, and who has to hand over to his wife 50 per cent more to keep the household going, is no better off than he was before. What is the solution? Once more we repeat: increased production and more efficient distribution will bring down soaring prices

The modern industrial world is a kind of machine. Raw material drops into the hopper of the machine, and out of it come finished goods. You are the steam engine, and the operative mechanism of that machine. You must produce more. The friction must be eliminated in the machine, which means that more lubricating oil and axle-grease (efficiency) must be used to make the machine run faster and produce more in a given time. The man with the wheelbarrow on the inclined plane also pushes home the point. We need mechanical aids. Walking up an inclined plane, a man can raise a load that he could not possibly lift alone on the level



As the picture below shows, we strike a balance between the purchasing power of money and the goods it buys. Somehow, the goods are constantly getting heavier, so that we must throw more and more money into the opposite side of the scale. To make our money purchase more than it is purchasing now we must produce still more goods

Jostling the Clouds to Change the Weather

Rain-makers, hail-preventers, and their strange devices

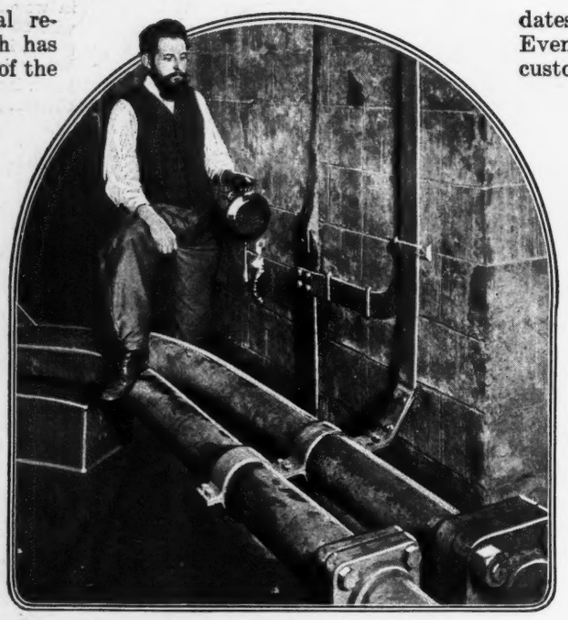
MARK TWAIN'S immortal remark that, though much has been said on the subject of the weather, very little has ever been done about it is one of those epigrammatic assertions that will hardly bear comparison with the facts. It is true that most people accept the weather philosophically as something that cannot be cured and most therefore be endured; but the aggregate of those who, from the earliest historic times down to the present, have declined to assume this acquiescent attitude would certainly populate a New York or a London.

Attempts to reverse the law according to which man is subject to the caprices of the weather have taken an immense variety of forms, and have not always been unsuccessful. When a farmer plants a grove of trees around his house to serve as a windbreak he is in a fair way to modify the weather over a small area of the earth's surface. When a horticulturist lights smudge fires in his orchard on a frosty night he certainly produces a kind of weather in the neighborhood of his trees that would not have prevailed there if Nature had been left to her own devices. Every human dwelling provided with a fireplace, stove or furnace alters the weather within a few hundred cubic feet of the atmosphere, producing an artificial summer in the midst of wintry blasts.

We did not, however, set out to describe these small-scale experiments in weather-making. It is literally true that hundreds of thousands if not millions of human beings have undertaken to control such major phenomena of the elements as rainstorms and thunderstorms, hail, tempest and sunshine.

Weather-Conjuring Is Not New

In that wonderful record of human delusions, "The Golden Bough," Dr. Frazer devotes about ninety pages to a rapid enumeration of the superstitious methods of controlling the weather that have found credence among the various races of mankind. The art of rain-making was practiced by the Chaldean astrologers, who passed on some of their ideas and practices to the Greeks and Romans. To this day there is hardly a savage tribe to be found anywhere in which rain-making, as well as other forms of weather-conjuring, is not one of the regular duties of the shamans or medicine men.



"Electric Niagaras" are popular in France. A "Niagara" is a large copper lightning-rod, installed in a church steeple or any tall building. It draws down "torrents" of electricity

Even the War Has Not Checked the "Hail-Rod" Man in Europe

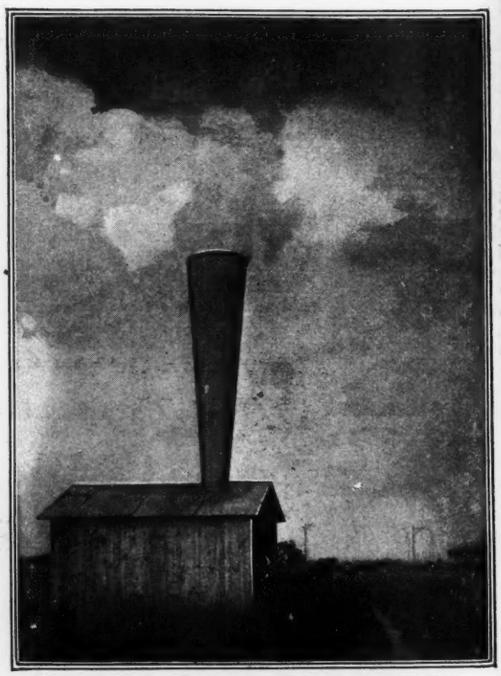
That faith in weather-making lingers even in highly civilized communities is easy to understand, if one considers the enormous value of good weather, in terms of dollars and cents, and the tendency of the wish to become father to the thought when evidence is being weighed. Not a year passes without the announcement of some experiment in the production of rain in the semi-arid regions of our country and others. In Europe even the great war has not checked the erection of "hail-rods" and the discharge of precious ammunition against that perennial enemy of the farmer and vine-grower, the hail-storm.

The campaign against hail constitutes the most striking chapter in the history of weather-making. The practice of "hail-shooting" antedates the invention of gunpowder. Even in remote antiquity it was the custom to shoot arrows or hurl javelins at the gathering hail-clouds, and the firing of cannon to avert hailstorms was in vogue centuries ago in Styria and northern Italy, and was well established in France before the Revolution.

Early in the nineteenth century a more popular expedient was the erection of hail-rods, or *paragreles*, consisting of tall metal-tipped poles connected with the ground by a cord or wire. These devices were imitated from lightning-rods, and were intended to draw off the electric charge from the overhanging clouds, the idea being that without electricity no hail would form. At least a million of these rods were set up in various parts of Europe.

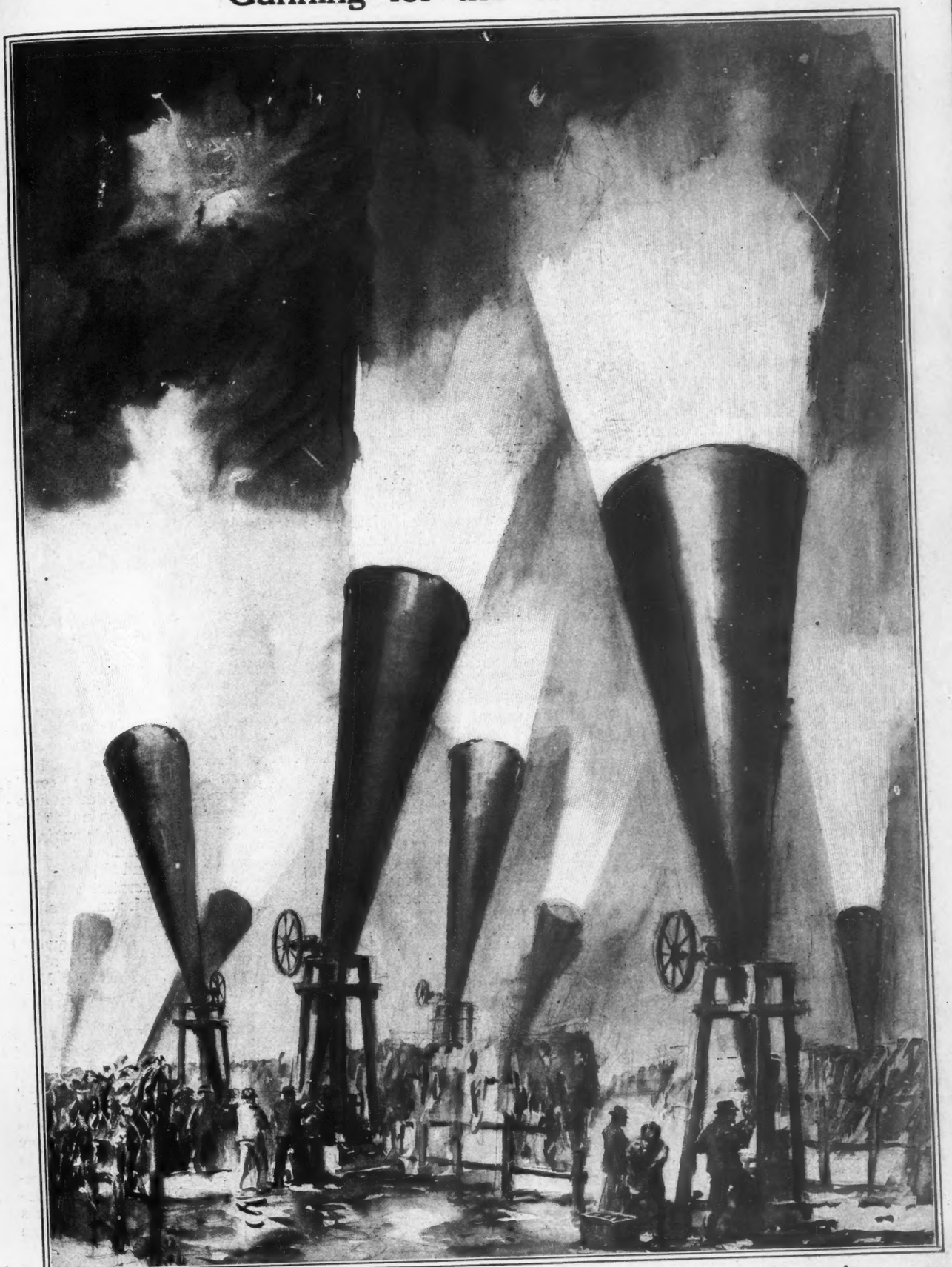
Gassing the Hail Storm

In recent times history has repeated itself, and both hail-cannon and hail-rods have been revived. The new vogue of the hail-cannon began in 1896, when a special form of mortar was introduced for the protection of



The gun is mounted on a tripod. Its mouth is fitted with a long sheet-iron funnel. No projectile is fired, but a whirling ring of gas and smoke is sent aloft by the discharge. This is supposed to produce the desired hail-preventing effect

Gunning for the Weather



"Hail-shooting" is older than gunpowder; for even in remote antiquity it was the custom to shoot arrows or hurl javelins at the gathering hail clouds. Nowadays the clouds are bombarded with special artillery. The old idea that cannon-fire precipitates rain dies hard. In Europe the new fashion of megaphone-like cannon began in 1896. By 1900 at least 10,000 cannon had been installed in Italy and 2,000 in Austria-Hungary, not to mention the hundreds erected in France. This picture shows an exhibition of hail cannon in Italy

The most pretentious of all "electric Niagaras" was that installed in the famous Eiffel Tower some years ago

che vine-growing district of Windisch-Feistritz, in Styria. The gun was mounted on a tripod, and its mouth was fitted with a long sheet-iron funnel. No projectile was fired, but a whirling ring of gas and smoke was sent aloft by the discharge and this was supposed to produce such disturance in the atmosphere as to interfere with the normal mechanism of the storm.

The use of these guns spread rapidly, until by the year 1900 at least 10,000 of them had been installed in Italy and 2,000 in Austria-Hungary, while they had also been extensively adopted in France. More recent explosive devices consist of bombs and rockets, which are claimed to be more efficacious than cannon because they concentrate their effects at the level of the clouds.

Scientific commissions, appointed by the Austrian and Italian governments to investigate the various methods of hail-shooting, pronounced them worthless. Apart from the results of actual experiments, there were two good reasons for arriving at this conclusion; one was that in no case did the explosions produce any appreciable agitation of the air at the great altitude where (as proved by its icy character) hail is formed; and the other was that even if the explosions should occur at such altitudes there was no reason to suppose the formation of hail could be prevented thereby.

They Have "Electric Niagaras" in France

About the year 1899 a new form of hail-rod was introduced in France, and this has since become the favorite means of protection against hail in that country. It is essentially a large copper lightning-rod, installed in some cases on church steeples or other buildings, but more often on tall steel towers erected for the purpose. This device is fantastically called an "electric Niagara," because, according to its promoters, it draws off "torrents" of electricity from the clouds.

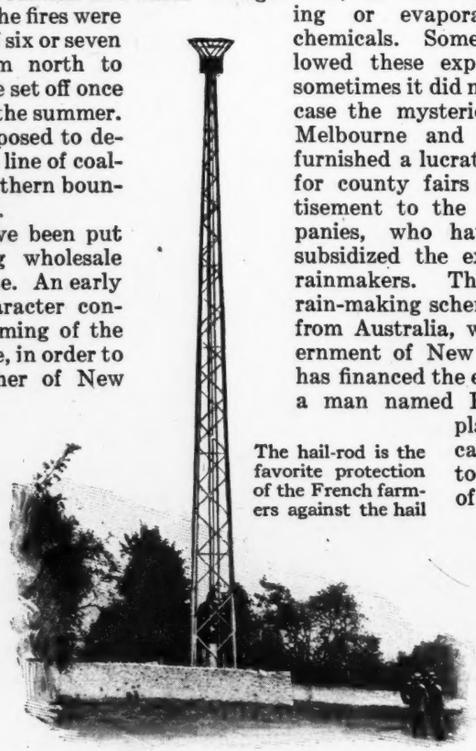
About one hundred Niagaras have been installed in France, some of them being set up in rows across the habitual paths of hailstorms, when they constitute so-called "barrages." Their construction and the observations of their effects have been carried on under the direction of a special committee appointed by the French Government.

Similar devices have been erected in Argentina, and plans for introducing them in South Africa were near consummation at the time the war broke out. The consensus of scientific opinion, however, strongly discredits their utility, and a propaganda against their use has also been waged, for obvious reasons, by the numerous hail insurance companies.

Climate of the U. S. Worries Weather Wizards

Other weather-making schemes have been numerous and varied. In the year 1845 a pioneer American meteorologist, James P. Espy, proposed the use of great fires in the western part of the United States in order to regulate the rainfall and winds to the eastward. The fires were to extend in a line of six or seven hundred miles from north to south and were to be set off once a week throughout the summer. Another genius proposed to destroy blizzards by a line of coal-stoves along the northern boundary of the country.

Several plans have been put forth for producing wholesale alterations of climate. An early scheme of this character contemplated the damming of the Straight of Belle Isle, in order to improve the weather of New England and the Canadian provinces; while a few years since a proposal to build an enormous jetty eastward from Newfoundland for the purpose of "protecting the warm north-flowing Gulf Stream from the onslaughts of the ice-cold south-flowing Labrador Current" actually received serious attention from Congress.



The hail-rod is the favorite protection of the French farmers against the hail

Jostling the Clouds to Make Rain

The rain-maker we have with us always. The ancient and apparently immortal delusion that rain can be produced by jostling the clouds with the aid of explosives received much encouragement in 1890-92, when experiments of this character were carried out near Washington and in Texas by R. G. Dyrenforth, with the aid of a Congressional appropriation. The experiments themselves were inconclusive, but they helped keep alive an unfortunate fallacy. In 1911 and 1912 the late C. W. Post, of breakfast food fame, revived the gentle art of bombarding the clouds to produce rain and became involved in a lively controversy with the Weather Bureau on the subject.

In 1891 L. Gatham, of Chicago, patented a method of producing rain, which consisted of liberating in the upper air, by means of bombs controlled by a time fuse, quantities of liquefied carbonic acid gas. His idea was that the instantaneous evaporation of this substance would chill the air over an extensive area to such a degree as to condense its moisture and precipitate it upon the earth.

This is but one of several proposed chemical methods of rain-making. From 1891 onward much was heard of one Frank Melbourne, known as the "rain wizard," whose procedure consisted of locking himself in a barn, freight car, or the like, and burning or evaporating certain chemicals. Sometimes rain followed these experiments and sometimes it did not; but in any case the mysterious doings of Melbourne and his imitators furnished a lucrative attraction for county fairs and an advertisement to the railway companies, who have frequently subsidized the exploits of the rainmakers. The very latest rain-making scheme is reported from Australia, where the government of New South Wales has financed the experiments of a man named Balsillie. His plan is to send up captive balloons to an altitude of a mile or more equipped to produce electrical discharges which are supposed to ionize the air sufficiently to promote condensation.

Decrease Your Waist-Line—Increase Your Life-Line

What's more you can do it without exercise

AN examination of 186,579 policy-holders in forty-three American life insurance companies has shown that the heaviest mortality is found among men and women who are between forty and forty-four years old and who are from fifty to eighty pounds overweight. In other words, the overweight man or woman of middle age is likely to die prematurely. If you want to live long, get rid of the fat around your waist line.

In the face of these facts, physicians have long preached the gospel of exercise. The body must be rid of the wastes that clog it and poison it. A man is a moving animal. But most of us don't move—don't exercise. We haven't the time. There are many duties that keep us at our desks. Our waist-lines increase, and our life-lines decrease. We "put on fat," as the saying goes; we do nothing to eliminate the poisons that mean kidney trouble, high blood-pressure, hardening of the arteries. We grow old before our time.

All this we have been told over and over again. "I have no time for exercise," we say.

What is wanted is a time-reducing method of exercising. Jack Cooper, of Stamford, Conn., who has trained thousands of prominent men and women, has met this need by inventing an apparatus that does in fifteen minutes a day what could ordinarily be accomplished only in an hour of unpleasant gymnasium exercise. Inside of a cabinet is a fixed, wheelless bicycle. You enter the cabinet, seat yourself in the saddle, close the doors after you, lower the top so that only your head protrudes through an adjustable neckpiece that fits snugly around your throat, and start to pedal.

The machine invented by Jack Cooper, trainer of thousands of prominent men and women, for reducing fat. Inside of a cabinet is a fixed, wheelless bicycle and an electric heater. Exercise on the bicycle causes profuse perspiration which throws off clogging poisons

Within the cabinet is an electric heater. The heat can be controlled by thrusting your hand through the top cover and pressing switch buttons within easy reach. In a few minutes you are perspiring freely. You enjoy all the benefits of bicycling and all the benefits of a Turkish, Roman and Electro-therapeutic bath. In a word, you rid yourself of your clogging poisons and your superfluous tissue; you keep "fit"; you do not age before your time.

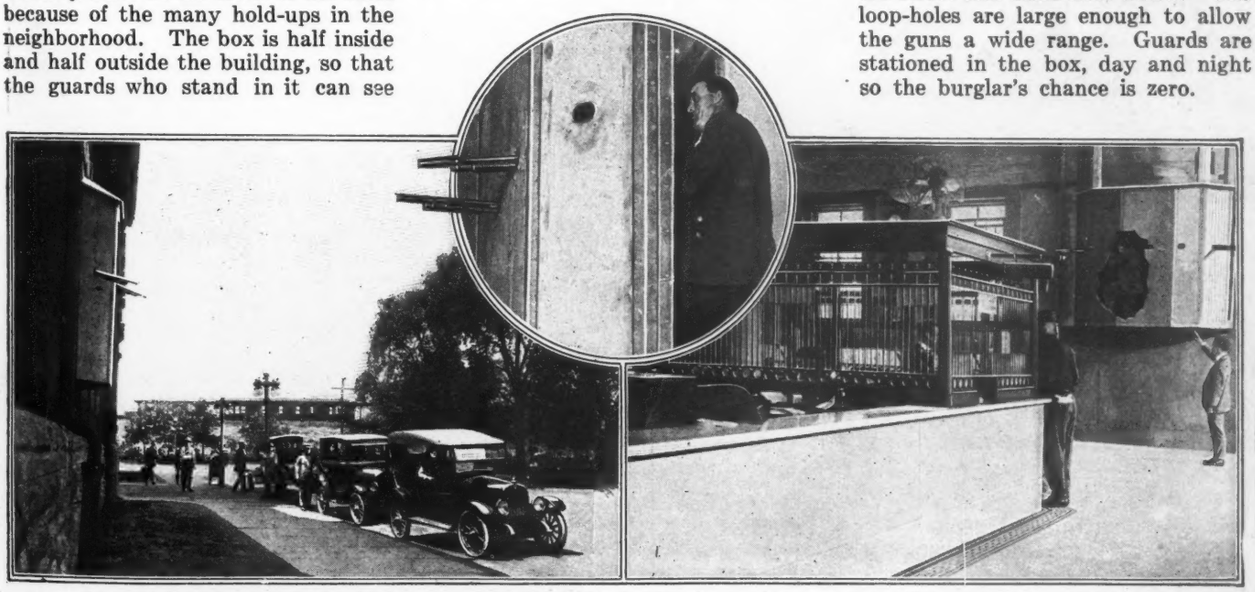
The bicycle is provided with a brake which can be adjusted in accordance with the amount of physical effort that you are able to put forth. In Mr. Cooper's opinion, the daily use of the hill-climbing muscles for fifteen minutes a day, accompanied by generous perspiration, will keep a busy man or woman in condition. That is why his machine assumes the form of a stationary bicycle.

Burglars Have Crossed One Bank Off Their List

"STEER clear of the Pullman Trust and Savings Bank," one Chicago bank robber says to another these days.

They have heard about the steel sentry-box that was recently built on the front of the bank because of the many hold-ups in the neighborhood. The box is half inside and half outside the building, so that the guards who stand in it can see what goes on inside the bank as well as in the street.

They are equipped with shot-guns and high-powered rifles that fit through loopholes and point coldly down at the street and bank floor below. The loop-holes are large enough to allow the guns a wide range. Guards are stationed in the box, day and night so the burglar's chance is zero.



Better look honest or the sentry might think you are a bank thief

Day and night the bank is guarded by sentries in this steel sentry-box

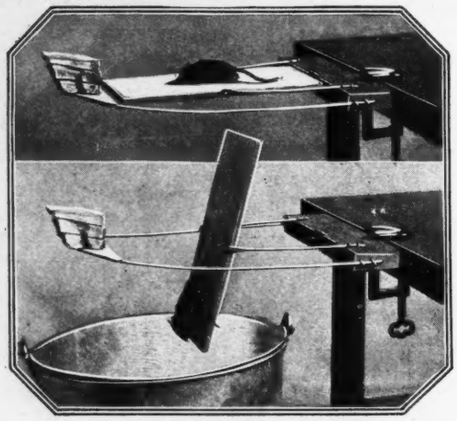
The inside of the bank is just as formidable to thieves as the outside

Still Another Mouse-Trap to Add to Your Collection

WALKING the plank—a source of innocent merriment and an easy way of killing captives, greatly indulged in by the pirates of yore—has been revived. But, fortunately, the victims now are mice and the plank is part of a mouse-trap invented by Humbert Pierini, of Greenville, Miss.

The trap is divided into three sections: the first is simply a block of wood, which is fastened to the edge of the table after the manner of a meat-chopper. Next comes the plank, and lastly the stand on which the bait is placed.

The mouse on the table smells the bait, and rushes across the plank to reach it. But when he has just passed the half-way mark, the plank tips over and drops him into a waiting pail of water. The plank then swings back to its natural position and is ready for another victim to walk the deceptive plank.



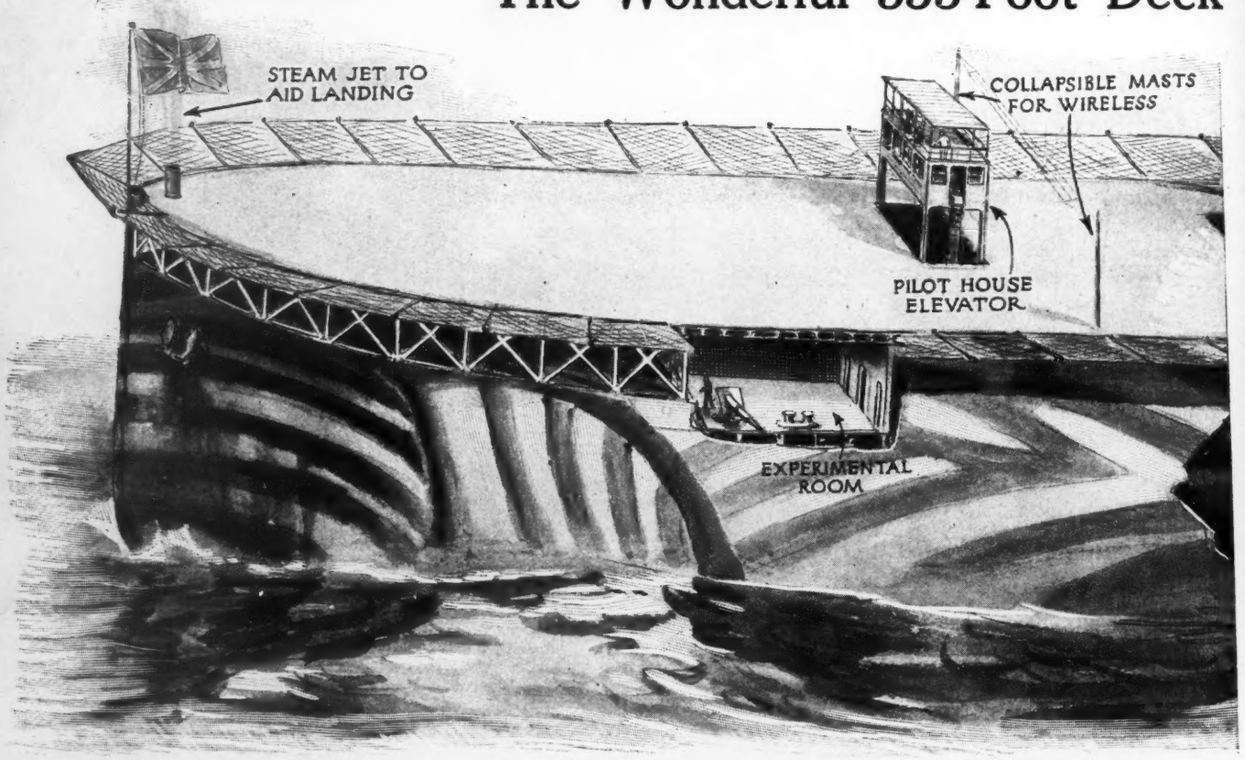
The unsuspecting mouse trips across the plank toward the bait—but he will never get there; for after he passes the half-way mark the plank tips and drops him into a pail of water. The plank then swings back to its original position, ready for another victim to venture confidently on it

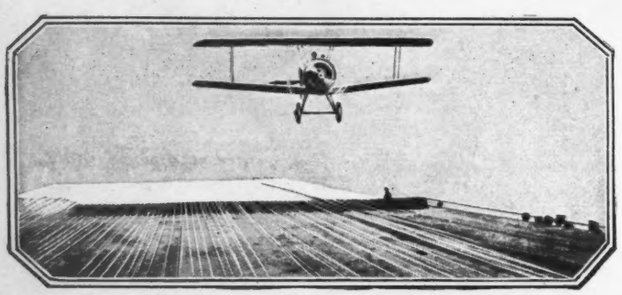
The plank tips under the weight of the mouse because the balance of the plank is disturbed. It swings back into place because the end near the table is slightly heavier than the far end.

One enthusiastic user writes: "Man! That trap simply mops up the mice. We caught twelve one night, nine another, and six another night." I hope that everybody who has small children will kill their cats and buy these traps."

Rather hard on the cats, but an excellent recommendation for the mouse-killer which, by the way, will not catch rats, we are told. Why? Perhaps because the rat is so long that its front paws have reached the bait before its hind paws pass the turning point; but most likely, because rats swim and are remarkably good climbers.

The Wonderful 535-Foot Deck





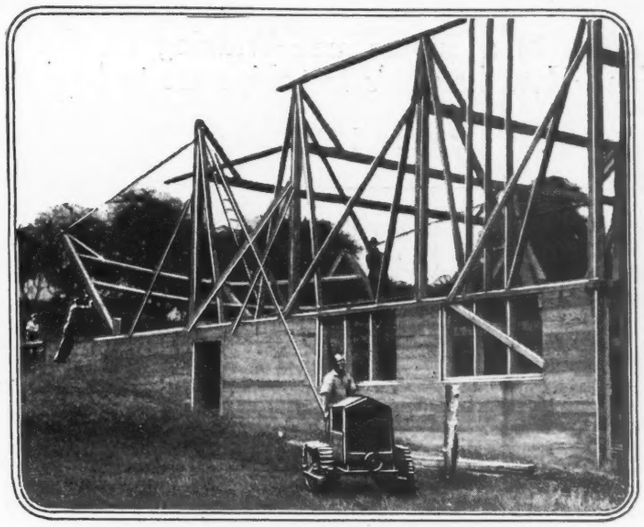
THE seaplane-carrier *Argus* is the latest thing in airplane mother ships. For her entire length of 535 feet, the flying-deck upon which the seaplanes start and land is entirely free from all obstructions of any kind whatever. In this respect the vessel is more advanced than the battle-cruiser *Furious*, which has been described and illustrated in the POPULAR SCIENCE MONTHLY, because the *Furious* had such obstructions on the flying-deck as her tripod mast, navigating bridge and stack.

The most important of the new ideas worked out to make the free flying-deck possible are horizontal smokestacks, which are placed directly beneath the flying-deck and discharge their smoke from the extreme rear of the vessel, where it does not interfere with the beginning or ending of the seaplane flights. Another

How One Man Beat the High Cost of Labor

IF you want to build a house for yourself, and cannot afford to pay for having it done because of the present scarcity and high cost of labor, you can do one of two things: give up your plan for the present and wait until you have enough money or until the cost of labor drops to a more reasonable level, or follow the example of the man in Newark, N. J., who built himself a house by his own labor, assisted only by a few friends and a small tractor.

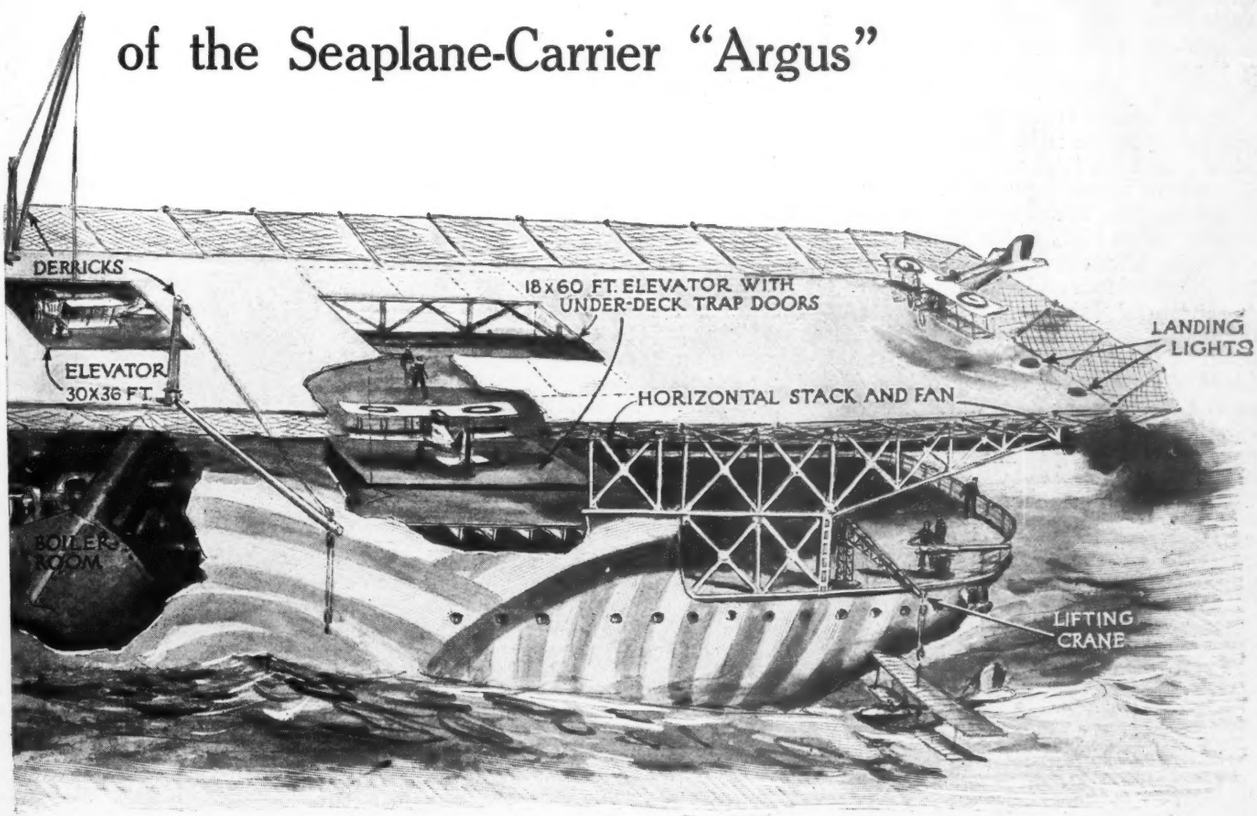
The accompanying picture illustrates his method. The basement part of the house is of concrete, the rest of framework. The enterprising builder cut and fitted the framework, and, assisted only by a few friendly neighbors, hoisted it into position by means of a small tractor. The illustration shows how he raised the complete framework of one side of the house to its proper position.



Nothing like a little tractor and a few helpful friends to beat the scarcity and high cost of building labor

The tractor, shown in the foreground of the picture, supplied the power, and the neighbors guided the posts to their proper places in the concrete base. In all probability it would have required the services of fifteen or more carpenters and building workmen to complete the work done by the owner, assisted by his friends and the little tractor, in approximately the same time.

of the Seaplane-Carrier "Argus"



new feature is an elevating pilot-house, the top of which is flush with the floor of the flying-deck when flights are in progress. When the vessel is under way, the entire pilot-house is raised high above the deck on four stilt-like legs, so that the officers may see to navigate more easily than from the permanent navigating bridge, located below the flying-deck.

The *Argus* was not designed as a seaplane-carrier. She was built in Great Britain for an Italian shipping company, and was taken over soon after the war broke out. The construction of the flat flying-deck is the most conspicuous change made in the design. This deck runs her entire length, and extends for her clear width of sixty-eight feet. The flying-deck is built above the highest or top-most deck of the boat as originally designed, and is mounted on a series of vertical column-like plates with suitable braces, so that the space between the main-deck and the flying-deck is left as open as possible. This was done because wind-tunnel tests conducted by the Admiralty had shown that the best results could be obtained when driving the vessel at speed by leaving the flying-deck as open as possible. The *Argus* has a maximum speed of twenty and three-fourths knots and a service speed of twenty knots.

The next most noticeable change is the horizontal stacks as shown by the broken-away sections of the ship. In the space between decks ordinarily used for cargo a great hangar has been built, capable of holding twenty service planes of the largest type. A thermo tank heating unit is provided, also racks on the walls for torpedoes and radiators to keep the hangar warm, so that men can work in it comfortably even in the coldest North Sea weather

A Visit to Davy Jones's Locker

Going down in a submarine—Walking on the bed of the ocean—How the war's lost ships are to be recovered

By Lloyd E. Darling

THIS article takes you down in Mr. Simon Lake's new salvaging submarine, the "Argosy" and "Argonaut." The character of this vessel, or combination of vessels, is made apparent from the drawing. With vessels of this type the bottom of the ocean is to be explored, cargoes and ships sunk during the war recovered where possible, and salvaging work in general carried on.

The buccaneers of old could get no more wealth than now lies on the bed of the ocean awaiting our hand. Mr. Simon Lake gave us the opportunity of inspecting his craft and of actually walking on the bottom of the sea. The machine is exceedingly practical.—EDITOR.

GETTING down into the submarine *Argonaut* is no very difficult process. You clamber up into an open hatchway at the front of the *Argosy*, and find yourself at the mouth of a huge steel pipe, four and a half feet in diameter. Descending the pipe is a good deal like going down an ordinary stairway. Really, it is a kind of half-ladder, half-stairway. Angle-irons riveted to the wall are the steps.

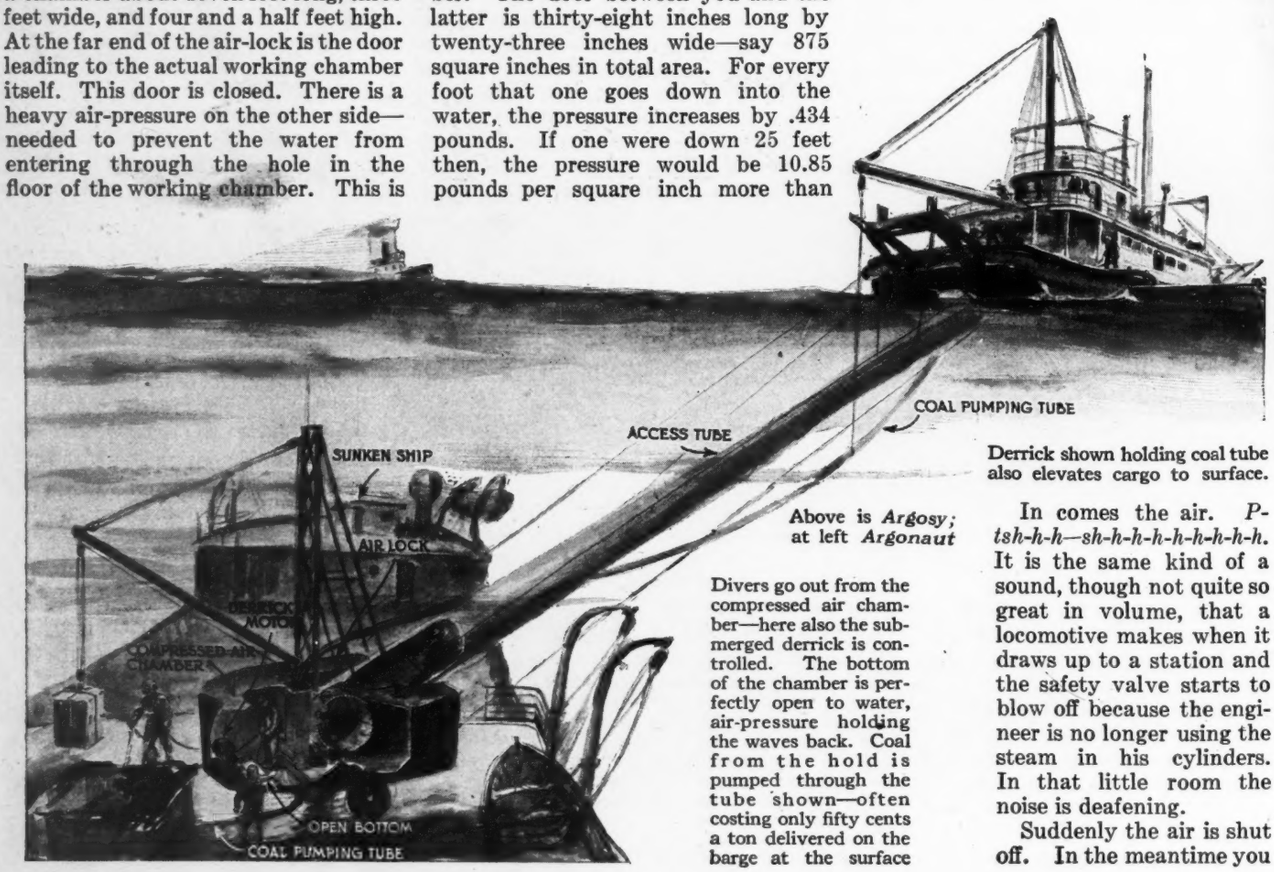
After descending about ten feet you find yourself at an elbow in the pipe. It stops going straight down and heads off toward the *Argonaut*, the particular angle downward depending on the amount she happens to be submerged at the moment. Electric lights illuminate the passageway.

At the far end is a steel wall barring progress. At the right, however, and within the huge joint which holds the access tube to the *Argonaut*, there is a round opening, about two feet in diameter, which leads to the "air-lock," a chamber about seven feet long, three feet wide, and four and a half feet high. At the far end of the air-lock is the door leading to the actual working chamber itself. This door is closed. There is a heavy air-pressure on the other side—needed to prevent the water from entering through the hole in the floor of the working chamber. This is about four feet by two and a quarter feet in size. Through it the actual operations on the bottom of the ocean or on a submerged ship are carried on.

As is evident, the air-pressure in the little room you have just crawled into must equal that within the actual working chamber itself, or you would never get the door between the two open. This is precisely what this little room, the "air-lock," is for. Like the lock in a canal through which a ship passes to gain a higher level, so this air-lock exists to raise the air-pressure that surrounds you up to the higher level of that within the working chamber. The door between you and the latter is thirty-eight inches long by twenty-three inches wide—say 875 square inches in total area. For every foot that one goes down into the water, the pressure increases by .434 pounds. If one were down 25 feet then, the pressure would be 10.85 pounds per square inch more than the approximately fifteen pounds per square inch always on the earth's surface. If the door has an area of 875 square inches, as we figured, and there is a push of 10.85 pounds on each square inch, it appears that there is a total of 8,750 pounds pushing on the whole door, roughly—about four and a half tons! Obviously you couldn't get the door open and yourself into the operating chamber without the use of this intervening air-lock. Using the air-lock, one can get up a balancing pressure and overcome the four and a half tons.

Once inside the air-lock, the door is closed behind you. It is locked from the inside. Simon Lake seizes a piece of heavy iron bar lying on the floor, and pounds the door and the locks even tighter. This is to make sure no air escapes. He then turns a valve.

It gives you a creepy sensation—turning that valve. You know how a chicken must feel when he sees the axe descending. But it is only momentary.



Above is *Argosy*; at left *Argonaut*

Derrick shown holding coal tube also elevates cargo to surface.

Divers go out from the compressed air chamber—here also the submerged derrick is controlled. The bottom of the chamber is perfectly open to water, air-pressure holding the waves back. Coal from the hold is pumped through the tube shown—often costing only fifty cents a ton delivered on the barge at the surface

In comes the air. *P-tsh-h-h—sh-h-h-h-h-h-h-h-h.* It is the same kind of a sound, though not quite so great in volume, that a locomotive makes when it draws up to a station and the safety valve starts to blow off because the engineer is no longer using the steam in his cylinders. In that little room the noise is deafening.

Suddenly the air is shut off. In the meantime you

have been swallowing, pinching your nose, and endeavoring to get the Eustachian tubes that lead from your throat to your ears under the same air-pressure as that coming into the room. Otherwise your ear-drums would protest unmistakably against the pressure. Mr. Lake has shut off the air, so you may have a few moments in which to accustom yourself to the increased pressure. Then he reaches for the valve again.

P-t-sh-h-h-h-h-h! On it comes again. In a few moments it begins to lose its sharp whistle, eases off into a long-drawn-out sigh, and then ceases altogether. The reason for this is that the air has been coming from the working chamber, and now ceases because the pressures in the two rooms have become equal. Obviously it should now be possible to open the door connecting the two. You find that Mr. Lake is already pounding on the door's latches. A few more pounds, and presto! the door swings open. The air-lock has served its purpose—let you conquer the barrier. You and the others scramble through the opening.

You find yourself in a little steel-riveted, steel-plated room, shaped as to floor and ceiling a good deal like the bottom of a flat-iron, and about seven feet high. In reality it is the prow of the under-water boat. This accounts for its triangular or flat-iron shape.

The Hole in the Floor

But the thing that attracts your attention above all else in the room is a hole in the floor about two and a fourth by four feet. There is water in that hole. There are all kinds of shells lying down there, stones, and many weird objects.

It's the bottom of the ocean you're looking at. Suddenly some kind of sea-denizen that probably calls himself a crab of a sort heaves into view. He has a shell on his back, and four or five legs sticking out on each side, and all told, legs and all, he is about as big as the palm of your hand. Evidently local society down here disdains to go forward and backward as is the custom in regions above, for he or she locomotes sideways, and really can dart through the water at a remarkable pace even though sidestepping it all the while. Interesting customs the natives have down here.

A fish comes plowing into view. He apparently doesn't like the scenery just above him, and veers off and out of sight. It's lucky for him he did, for Mr. Lake is already standing over the opening, waiting, a spear in his hand, for anything that may come along.

Look! Here comes something crawling over the bed of the sea. It looks like an army tank headed for somewhere. It has a big horseshoe-shaped shell, and you can't see any legs, or wheels, or anything under it. You wonder how it gets along. Down shoots Mr. Lake's spear and Mr. or Mrs. Sea Tank is impaled as easily as if Mr. Lake had been aiming for the middle of a fried egg with a table fork. Up comes spear, sea tank and all. It proves to be a huge horseshoe crab, more than a foot across. What appear to be about two dozen legs wave wildly from each side of the shell as you pull it off the spear. You put the crab bottom upward on the floor of the boat where it can kick up its heels to its heart's content, and no harm done, for it is in the same predicament a turtle is when turned over on its back.

Simon Lake standing on the bed of the ocean, spearing fish and other sea denizens. Air-pressure holds back water at his feet—otherwise it would fill the room. From such an under-water room sunken vessels may be salvaged, oysters and clams gathered and a variety of other under-water work carried out

It dawns on you that you have forgotten you are under considerable air-pressure. It has all been so interesting, looking down through that opening on to the bed of the ocean, you have forgotten all about anything else. The truth is, the air-pressure within the far corners of your lungs, and at the back of your ear-drums has become the same as that within the room, and, except for a general sensation of heaviness, it is not noticeable.

Standing in that chamber and looking through the opening in the floor, one can realize very readily how it would be if one happened to pass over a submerged wreck. Nearly the whole vessel would stand out as plainly as a board at the bottom of a brook. It is really remarkable how much light gets to the bottom of the sea at ordinary depths. Most sea water, Mr. Lake says, is quite clear, in spite of the fact that one has a hard time realizing it when trying to look down into it from a boat at the surface. In Southern waters, particularly, one can frequently see two or three hundred feet with ease.

To Salvage Wrecks

Had there been wrecks close at hand in Bridgeport Harbor, it would have been possible to get over one, and perhaps walk on its deck. As it is, you may take off your shoes and stockings and stand in the opening, walking on the bed of the ocean as the submarine moves along. You can get a very good idea of how easy it would be to size up the condition of a sunken ship, get things from its interior, send out divers, and otherwise work with it, almost as easily as if it were but two or three feet under the surface. You have to concede that Simon Lake has turned out an exceedingly practical contrivance; and one of striking originality.

What Mr. Lake is going to do with his *Argosy* and *Argonaut* is perhaps best made evident by the following quotations from his book, "The Submarine in War and Peace":

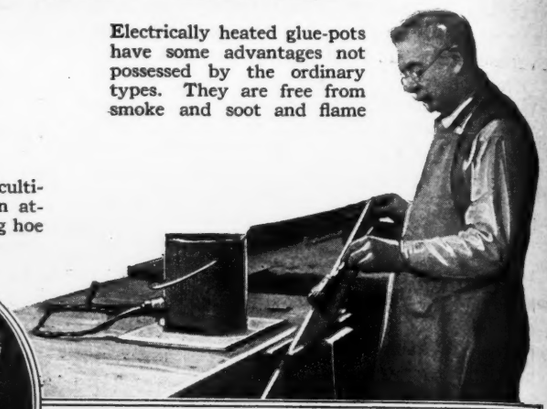
Somewhere off Bridgeport, Conn., lies the wreck of the old Sound steamer *Lexington*. Tradition has it that she has a fortune in her safe. Many a ship has been sunk in the waters about Hell Gate; search was carried on there for years for the old British frigate *Hussar*, which struck on Pot Rock and sank during the Revolutionary War. They tell that she had four million dollars (£820,000) in gold on board to pay off the British troops, and that she carried this treasure to the bottom with her. There is a cargo of block tin in a barge somewhere off the Battery, New York, and many a ship with valuable cargo lies along the coast from Newfoundland to Key West. The yearly loss in ships and cargoes throughout the world has always run into many millions of dollars, and since the war this has been multiplied a hundredfold, amounting to billions. The time will come when many of these ships will be found, and such of their cargo as is still valuable will be salvaged.

"Ships like the *Argosy and Argonaut* will get this booty," says Mr. Lake.

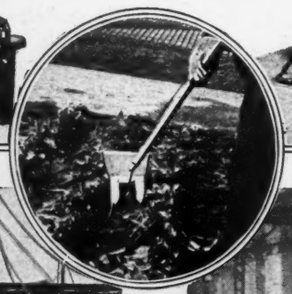
Do It with Tools and Machines

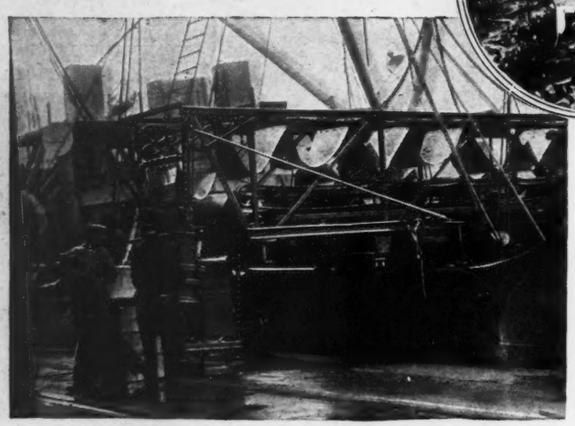
Much of the time lost in running back and forth in a wood-working shop may be avoided by the use of this light motor-driven bench saw

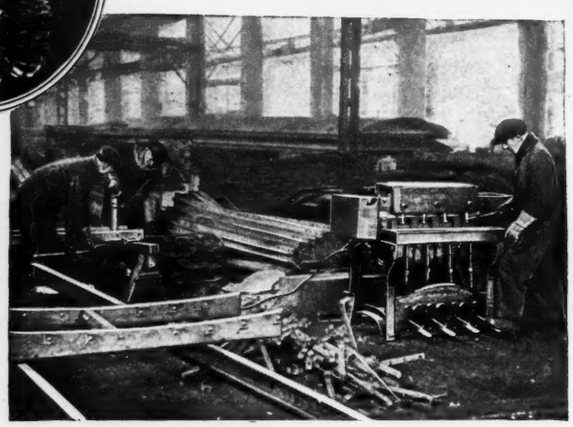
Electrically heated glue-pots have some advantages not possessed by the ordinary types. They are free from smoke and soot and flame



An inexpensive hand cultivator in the form of an attachment to a gardening hoe







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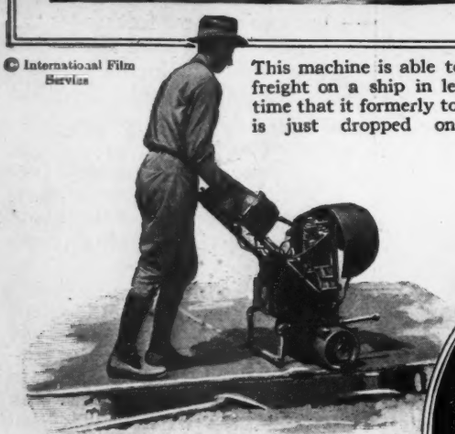
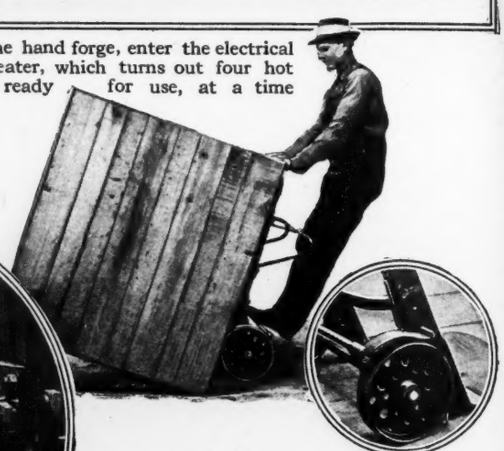
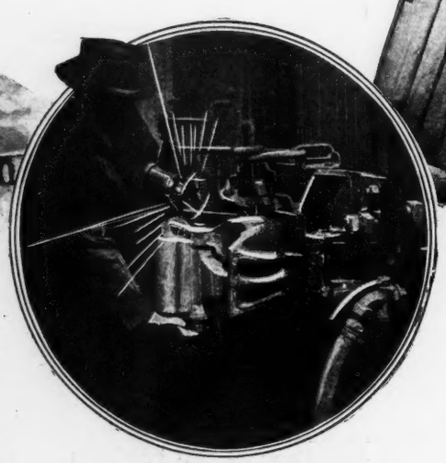
This machine is able to load or unload freight on a ship in less than half the time that it formerly took. The freight is just dropped on the conveyor



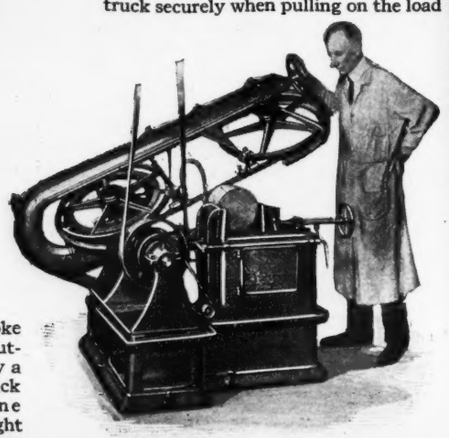
Exit the hand forge, enter the electrical rivet-heater, which turns out four hot rivets, ready for use, at a time

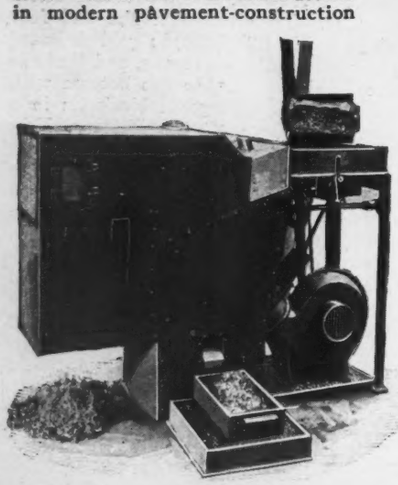




An unbalanced motorcycle engine as it is used for tamping newly-poured concrete. This is one of the latest devices in modern pavement-construction

A safety brake for the man-power truck is something that has been long wanted. It is operated by foot and holds the truck securely when pulling on the load



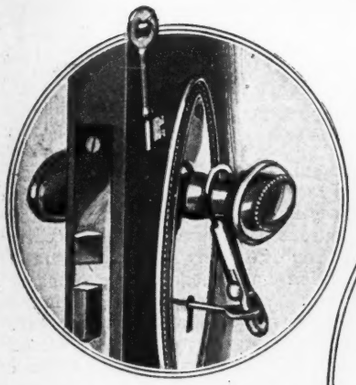


A hand lantern so constructed that a movement of the handle lights or extinguishes it. Long-lived four-cell batteries are used

This machine separates finished parts from the waste metal in the form of chips and shavings. A forced air draft does it

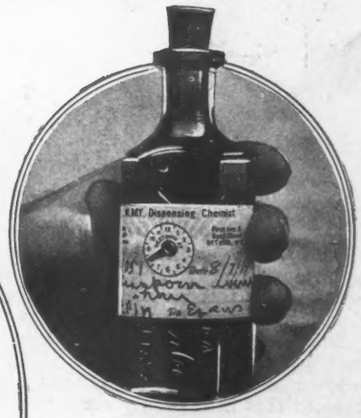
A continuous stroke band-saw for cutting metals. By a spring at the back of the machine the feeding weight is kept constant

Making Things Easier for the Busy Housekeeper



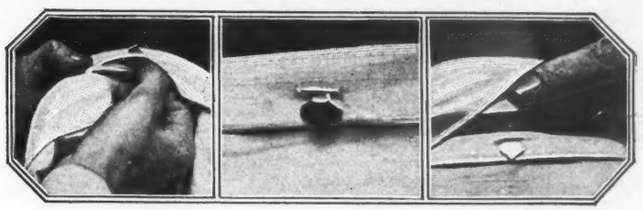
The key-fastener is secured to the door-knob. It is so constructed that it snaps to the key in the lock and prevents the door from being opened on the outside

After the hair is washed, this frame is placed under it, allowing whatever air is moving to circulate through the hair and dry it in half the usual time



"When shall I give the next dose?" doesn't bother the nurse who has this medicine bottle; it has a dial and pointer which designates the time for the medicine to be given again

Made from a steering column and wheel of an automobile, this lamp is a distinct novelty in that it is the only one of its kind



A decided novelty in collar buttons is this new one, which, when in position, folds neatly against the collar-band, doing away with that unsightly bunch at the back of the collar

When the owner of this tooth-brush finishes cleaning his teeth, he dips it into the sterilizing liquid and sets it into its holder

Just big enough for two is this picnic basket, which accommodates a small piece of ice for keeping the food and liquids cold

Water is kept moving in the washing-machine on a horizontal plane. It has no internal mechanism to get out of order and impair its efficiency

If there is a chair in the house that is wabbly, then why not attach a tin bottle cap underneath the bottom of the short leg to steady it?

The water is forced through the fabric of the clothing and cleans without injuring it. The motor and driving mechanism are entirely enclosed

Finding Your Way Among the October Stars

How the characters of an ancient legend may be found in the skies

By Ernest A. Hodgson

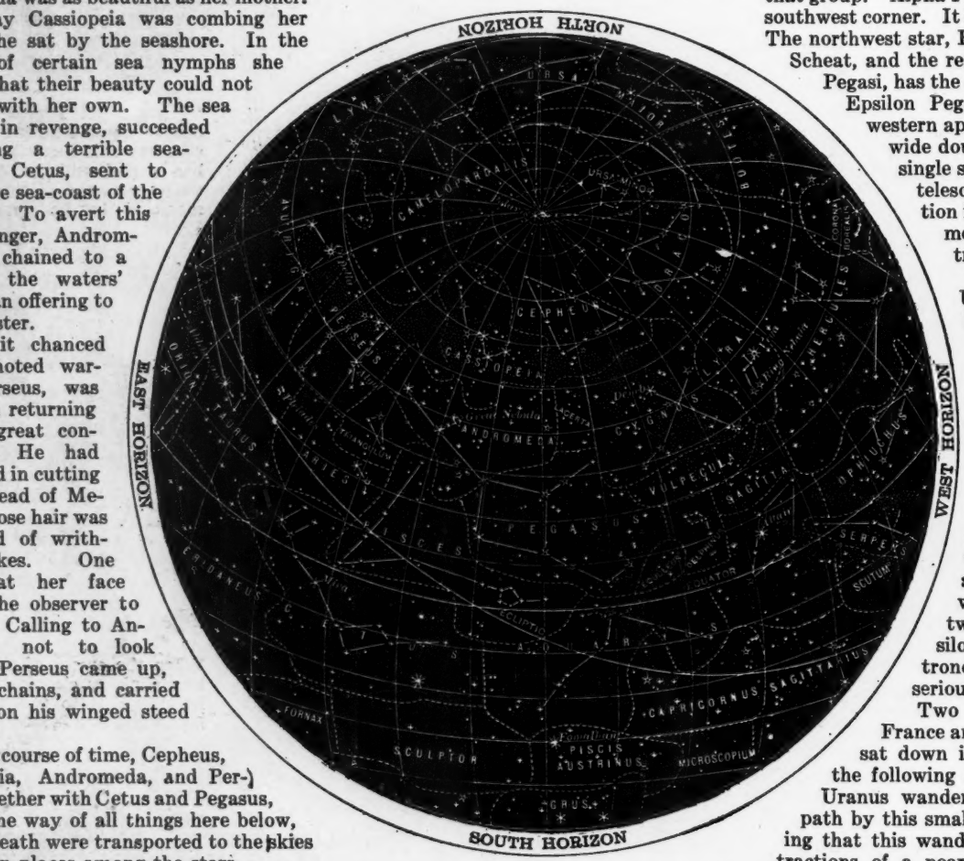
"ONCE upon a time," as the story books say, there ruled a great king in Ethiopia whose name was Cepheus. His queen, as beautiful as she was vain and as vain as she was beautiful, was called Cassiopeia. Their daughter Andromeda was as beautiful as her mother.

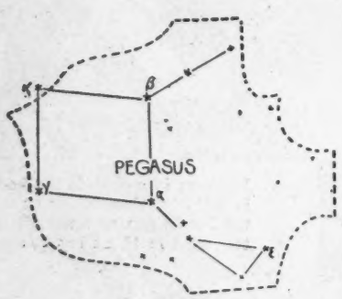
One day Cassiopeia was combing her hair as she sat by the seashore. In the hearing of certain sea nymphs she boasted that their beauty could not compare with her own. The sea nymphs, in revenge, succeeded in having a terrible sea-monster, Cetus, sent to ravage the sea-coast of the kingdom. To avert this great danger, Andromeda was chained to a rock at the waters' edge as an offering to the monster.

Now, it chanced that a noted warrior, Perseus, was just then returning from a great conquest. He had succeeded in cutting off the head of Medusa, whose hair was composed of writhing snakes. One glance at her face turned the observer to stone. Calling to Andromeda not to look around, Perseus came up, cut her chains, and carried her off on his winged steed Pegasus.

In the course of time, Cepheus, Cassiopeia, Andromeda, and Perseus, together with Cetus and Pegasus, passed the way of all things here below, and on death were transported to the skies and given places among the stars.

Looking directly overhead in the early evening of October, a great square can be seen. This marks the position of Pegasus. The other constellations may be picked out by using the circular star map. Tracing north through the two most westerly stars of the square, three times their distance brings one to the constellation Cepheus. A similar tracing through the easterly pair picks out Cassiopeia—a great W. Tracing southeast diagonally across the square brings us in about the same distance to Cetus, while tracing northeast across the diagonal indicates first Andromeda and Perseus.





Looking directly overhead in the early evening of October, a great square can be seen, marking the position of Pegasus

The Star Map for October

The map represents the sky as seen at the times listed below. It is specifically arranged for the latitude of New York, but is practicable for ten degrees on either side of this latitude.

September	6, midnight.
September	14, 11:30 p. m.
September	22, 11:00 p. m.
September	29, 10:30 p. m.
October	7, 10 00 p. m.
October	15, 9:30 p. m.
October	22, 9:00 p. m.
October	30, 8:30 p. m.
November	6, 8:00 p. m.
November	14, 7:30 p. m.
November	21, 7:00 p. m.
November	29, 6:30 p. m.
December	7, 6:00 p. m.

The magnitudes are indicated on the map by stars of various kinds as follows: 0 magnitude, open center; 1 magnitude, 8 points; 2 magnitude, 6 points; 3 magnitude, 5 points; 4 magnitude, 4 points; 5 magnitude, single dot.

All times expressed in Eastern Standard (not summer) time.

Pegasus is the best placed of all these constellations for observing in October. The uppermost easterly star belongs to the constellation Andromeda. It is Alpha of that group. Alpha Pegasi is the star in the southwest corner. It is also called Markab. The northwest star, Beta Pegasi, is named Scheat, and the remaining star Gamma Pegasi, has the proper name Algenib. Epsilon Pegasi, the star at the western apex of the triangle, is a wide double. It appears as a single star unless viewed in a telescope. Yet its separation is really great, as such measures run in astronomy.

When the planet Uranus was discovered by Herschel, its path was computed from many observations. We usually think of the paths of the planets as being smooth ellipses. It was found, however, that Uranus wandered from his computed place. This wandering was by an amount equal to that which separates the two components of Epsilon Pegasi. Yet astronomers considered it serious.

Two men, Le Verrier of France and Adams of England, sat down independently to solve the following problem. Given that Uranus wanders from its computed path by this small amount, and assuming that this wandering is due to the attractions of a near-by and hitherto unknown planet, determine the position of this planet.

Adams solved the problem and presented his solution to the astronomer Royal of England. The latter, thinking little of the ambitious attempt of the young astronomer, laid the manuscript away and forgot it. In the meantime Le Verrier solved the problem too, and sent his solution to his friend, the German astronomer Galle, telling him just where to look for the new planet. Galle found it the first evening he looked for it.

Look now at the little star Epsilon Pegasi. If you are fortunate enough to possess a good field-glass, examine the star with it, and you will see it twinkle into two.

Think then of the precision of astronomical instruments which permit astronomers to detect such trifling, and yet such significant, discrepancies in the paths of the heavenly bodies.

There are today discrepancies noted in the path of Neptune. Will a future Adams or Le Verrier compute for us the position of a ninth planet? Time will tell.

The Planets for October

THOSE who wish to view the planets in October must rise early enough to see them before sunrise. All will be invisible till then. Of the brighter planets Jupiter will rise first, about three hours before the sun. Then Mars, Saturn, and Venus follow in the order named. The last rises about an hour and a half before the sun, and appears low in the east—a morning star.

Examining the planet map, we note that the moon crosses the ecliptic very close to the point where the earth's shadow has come by October 31. By the time the earth's shadow reaches this crossing point, November 7, the moon will again reach this same spot. Then, instead of crossing above the shadow as it does this month, it will cross the ecliptic *behind* the shadow, and there will be an eclipse of the moon on November 7.

It will be seen, too, that the sun is coming close to the position on the ecliptic, where the moon again crosses. This month the moon passes below the sun. Next month by November 22 it will again come around to the crossing point of the ecliptic just in time to pass in front of the sun. There will be a partial eclipse then of the sun on November 22. The manner in which the moon just avoids the conflict with the earth's shadow and with the sun this month, and the way in which they are about to reach the crossing point together next month can readily be seen on reference to the above map.

There will be a conjunction of the moon with Jupiter on October 17, with Mars on October 19, with Saturn on October 19, and with Venus on October 19. There will be a conjunction of Mars and Saturn on the 24th.

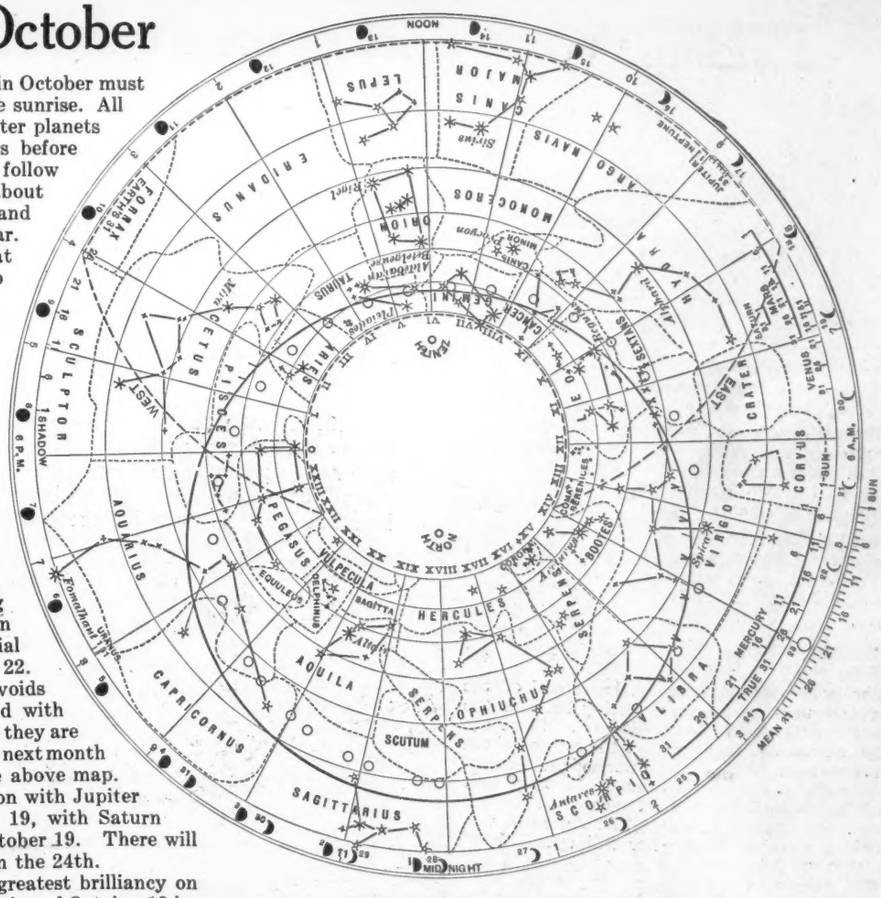
Venus, the morning star, attains its greatest brilliancy on October 19. Locating Venus on the morning of October 19 by means of its brightness, you will recognize the other planets from their relative positions as given in the planet map.

The time of the various phases of the moon may be computed by the method outlined in the June issue. The year number of the computation is 11 times 1919 minus 1911, or 88. The month number as picked out from the list

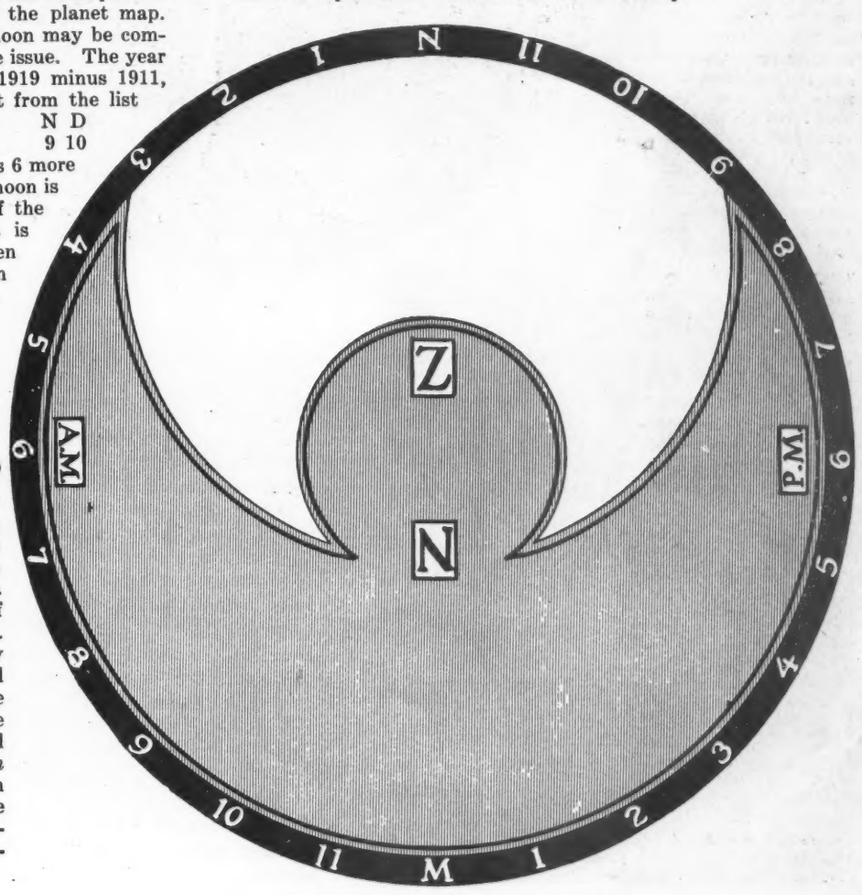
J F	M A	M J	J A	S O	N D
0 2	0 2	2 4	5 6	7 8	9 10

is 8, and the sum of 88 and 8 is 96, which is 6 more than an even multiple of 30. Hence the moon is 6 added to 1, or 7 days old, on the 1st of the month. This, then, is first quarter. It is fifteen days old on the 8th, i. e., it is then full. It is thirty days old, or new, on October 24, since 24 added to 6 makes 30.

These dates are all correct, as can be verified on reference to an almanac, with the exception of the last one, which is nearly a day out. The rule can only be trusted within a day, however, and that is quite sufficiently close for all general purposes.



To use this planet map, cut out the disk below and use it as explained in "How to Use the Planet Map"



How to Use the Planet Map

THE planet map indicates a belt thirty degrees wide on each side of the celestial equator. To use it, cut out the circular disk to the right and mount it on a thin cardboard disk of the same size. Run a glass-headed push-pin through the center of the disk, pinning it to the center of the map.

To see the section of sky visible at any time on any given date, turn the disk until the required hour on the disk is opposite the required date on the chart line of the "mean sun." To see when any celestial body rises or sets or reaches the meridian *on any date*, turn the disk so that the position of the body *for that date* on the map is in the required position with respect to the horizons. Read off the hour opposite the position of the mean sun *for that date.*

How the Popular Science Monthly

By Waldemar

In order to save the time now lost to England, the POPULAR SCIENCE be overhauled by airplane and press- her. Read here how the experi-

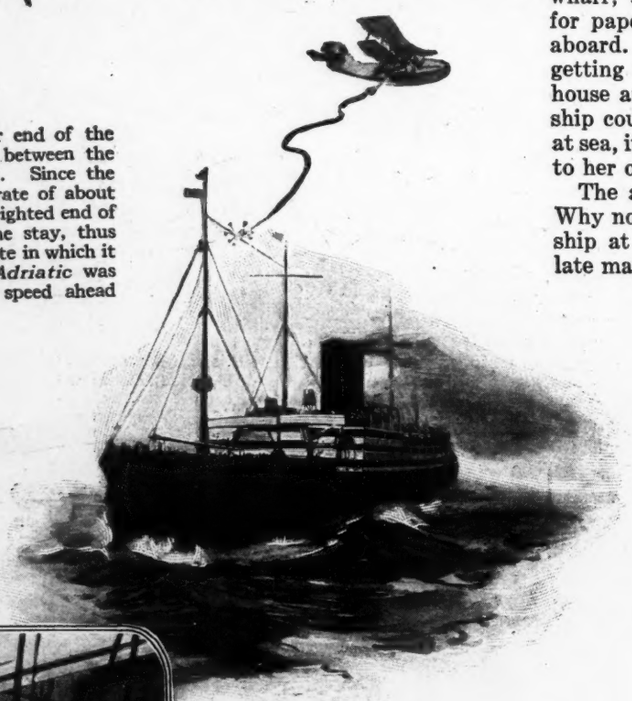
The mail-pouch was placed in an outer container, and the whole deposited in a chute on the side of the fly- ing boat. Two hundred feet of ceble trailed from the container behind the flying-boat

SUPPOSE you have a contract involving hundreds of thousands of dollars, and suppose that that contract must be signed in London by a certain day. The steamer has just left New York. She is seventy-five miles out at sea. If you can catch her and drop that letter of yours aboard, it will mean a fortune to you. If you must wait for the next steamer, a delay of perhaps a week is incurred, and all the work that you may have done may go for naught.

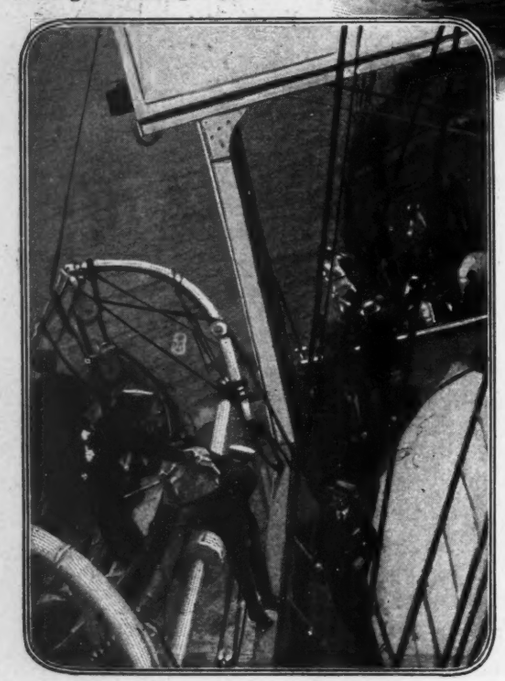
And then, consider the delays incurred by waiting for ships' manifests to be made out. It costs hundreds of dollars a day to hold a ship at the wharf; and yet, she must be held thus for papers until the last bale is taken aboard. Often the delay involved in getting the papers from the Customs house amounts to half a day. If the ship could sail and receive her papers at sea, it would mean dollars and cents to her owners.

The airplane at once suggests itself. Why not send a flying-boat out to the ship at sea and drop a mail-sack of late mail on board?

The branched and weighted lower end of the cable caught in the stay running between the fore mast and the fore mainmast. Since the flying-boat was travelling at the rate of about seventy miles an hour, the lower weighted end of the cable was whipped around the stay, thus jerking the mail-bag out of the chute in which it rested on the flying-boat. The *Adriatic* was making eighteen knots—her full speed ahead



In accordance with the program the bag dropped into the water and was hauled on board the *Adriatic* by the very cable which had served to jerk it from the flying-boat. The mail, of course, was packed in a strong waterproof floating Dreadnaught pouch



The Post-Office Carries Out the Popular Science Monthly's Idea

This Idea of the POPULAR SCIENCE MONTHLY was brought to the attention of the Post-Office Department. Mr. Otto Praeger, Second Assistant Postmaster-General gave instructions that the POPULAR SCIENCE MONTHLY'S idea should be carried out experimentally, and Mr. Thomas Patten, the Postmaster of New York, was instructed to cooperate with us.

Through the courtesy of Mr. David Lindsay, of the International Mercantile Company, the White Star Liner *Adriatic* was placed at the disposal of the POPULAR SCIENCE MONTHLY. Mr. Inglis M. Uppercu, President of the Aero Marine and Engineering Company, generously supplied one of his areo marine flying-boats.

After the preliminary arrangements were made, the Post-Office authorities, the Aero Marine Company's engineers, and the POPULAR SCIENCE MONTHLY'S editor held a conference in order to devise a safe and sure way of dropping the mail-pouch on board the *Adriatic*. It was finally decided that the *Adriatic* herself must in some way cooperate with the flying-boat in the air. The delivery of the mail-pouch to her must be as certain, almost, as if it were hoisted on

The lower end of the cable had seven branches, and each branch carried a two-pound bag of shot

Dropped Mail on a Liner's Deck

Kaempffert

by waiting for the next mail steamer MONTHLY proposed that a ship at sea ing mail matter dropped aboard ment was successfully carried out

board or carried on board from a wharf in the usual way.

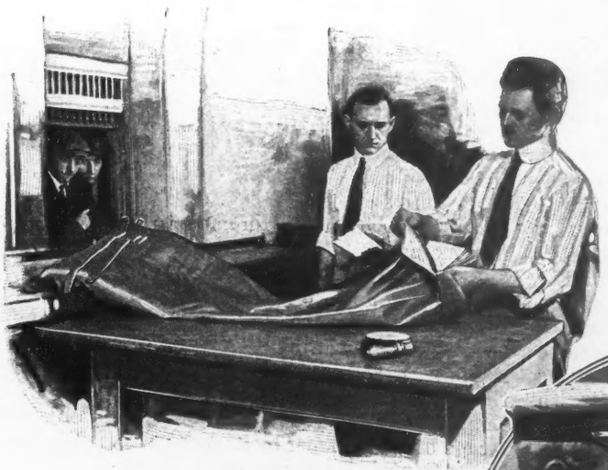
So it was finally decided that the mail-pouch was to be attached to one end of a steel aeroplane cable two hundred feet long. The other end of the cable was to be provided with seven short branches, each weighted with a two-pound bag of shot. Sailing over the *Adriatic*, the pilot of the flying-boat was to trail this two-hundred-foot cable, swooping down within a hundred feet of the *Adriatic's* foremast.

The lower end of the cable, traveling at seventy-five miles an hour, was to strike the stay running either from the bow of the ship to the top of the foremast, or the spring stay running between the foremast and the fore mainmast. At seventy-five miles an hour the cable would wrap itself around the stay and jerk the bag out of a chute in which it reposed at the side of the flying-boat.

Cyrus Zimmermann, the pilot, and Richard Griesinger his mechanic will go down in history as the crew that delivered the first bag of mail from an airplane to a steamer at sea. So thoroughly had Zimmermann drilled himself in the part he was to play that he deposited the mail sack on the *Adriatic* without a hitch. His was the plan of attaching to the bag a two hundred foot cable which wrapped itself around one of the stays of the *Adriatic's* rigging, a plan that proved feasible

Test to Make Sure the Plan Would Succeed

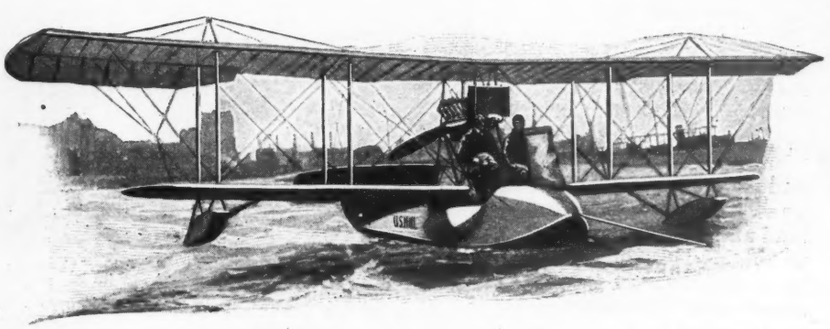
To make sure that this plan would succeed, experiments were conducted at the works of the Aero Marine and Engineering Company. The pilot assigned to the task, Cyrus Zimmermann, a man who had given a brilliant account of himself as a civilian instructor of flying in the Army, rigged up on land a wire corresponding with one of the *Adriatic* stays, and then determined whether or not it was feasible to jerk a hundred-pound bag of wet sand from a traveling flying-boat. The tests proved to be so highly successful that the system was adopted for the experiment.



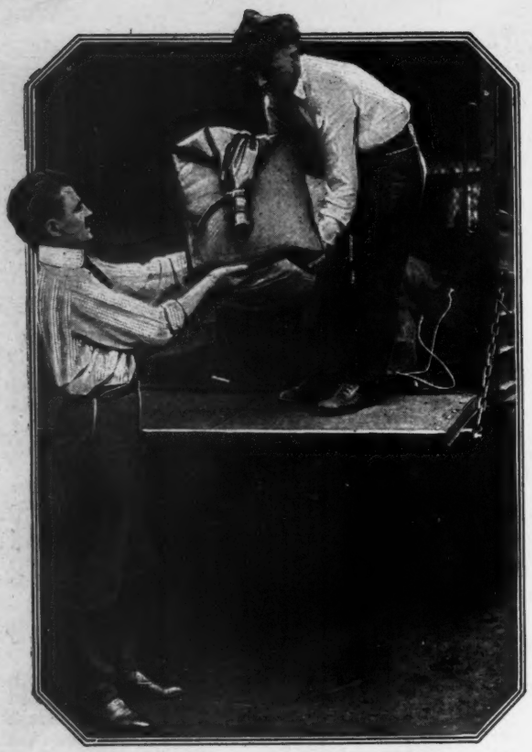
Since it was foreseen that the pouch would drop into the water provision had to be made for keeping the mail dry. Hence, the mail was sealed at the New York Post Office in a floatable water-proof Dreadnaught pouch. The construction of this pouch resembles that of the Dreadnaught life-saving suits worn by the British Trans-Atlantic Aviators. When the bag fell into the water it floated and was hauled aboard the *Adriatic* by the very cable that pulled it from the flying boat

It was considered desirable to provide a shock-absorber of some kind in the two-hundred-foot cable. Traveling at seventy-five miles an hour, it was estimated that the wire would strike one of the stays of the *Adriatic* with an impact energy of twelve thousand foot-pounds. Accordingly, stout rubber-band shock-absorbers, of the kind that are used on airplane landing gears, were inserted in the cable. The drawing at the top of page 84 reveals so clearly how the shock-absorbers were placed that further explanation is unnecessary.

Captain Ranson, of the *Adriatic*, who received the first package of mail ever delivered to a ship at sea by an airplane. What was in this epoch-making package? The answer is in his hands



The aero marine flying-boat that delivered the first bag of mail to a steamer at sea



The bag of mail was sent by motor-truck to the waiting flying-boat two hours after the *Adriatic* had left her pier

August 14, 1919, was the eventful day set for carrying out the POPULAR SCIENCE MONTHLY'S idea. A thirty-mile gale blew. It was one of the worst storms that New York had experienced in weeks. The weather conditions were about as unfavorable for so bold an experiment as could be imagined. But if late mails with valuable documents are ever to be delivered regularly at sea, wind and weather must be ignored. And so it was decided to proceed.

Wrapped in Floating Package

A water-proof mail-bag was especially made for the experiment by the Safety-at-Sea Corporation. It was a water-proof rubber bag, made floatable by applying the same principle followed in making the Dreadnaught life-saving suits which have been described in the POPULAR SCIENCE MONTHLY.

To drop a mail-pouch weighing one hundred pounds on the deck of a crowded transatlantic liner would be risky. Provision had to be made for dropping the mail-bag into the water as close as possible to the ship. Hence the Dreadnaught water-proof floating mail-bag was selected.

Two hours after the *Adriatic* had sailed, a pouchful of United States mail, and a package containing copies of the POPULAR SCIENCE MONTHLY, addressed to Captain J. B. Ranson of the *Adriatic*, were delivered to the flying-boat at the foot of Eighty-fifth Street and the North River. The mail-pouch was placed within a second bag, to which one end of the cable was attached.

Heading into the very teeth of the gale, Zimmermann sailed along fifty, one hundred, two hundred yards, and then vaulted into the air.

Catching Up with the Adriatic

Straight after the rapidly disappearing *Adriatic* the flying-boat speeded with its mail. Just off Scotland Lightship, near the end of the Ambrose Channel, Zimmermann, in the flying-boat, caught up with the *Adriatic*.

The craft, circling over the steamer like a great aquatic bird, provided a dramatic spectacle. Deciding, finally, that the moment had come for the crucial test, Zimmermann swooped down with his cable trailing within one hundred feet of the *Adriatic's* mast. The lower shotted end of the cable caught the stay running from the foremast to the fore mainmast of the *Adriatic*.

At once the mail-pouch was jerked out of the chute on the side of the flying-boat. The sack dropped into the water on the port side of the *Adriatic*, exactly as those in charge of the experiment had foreseen. In less than a minute it was hauled up to the bridge of the steamer by its own cable. There Captain Ranson opened the container, took out the package addressed to him, which contained copies of the POPULAR SCIENCE MONTHLY, and distributed them to the officers and officials of the White Star Line on the bridge.

Thus simply was the feasibility of applying the flying-boat for saving precious hours demonstrated.

Drop Mail on Steamer Two Days Out

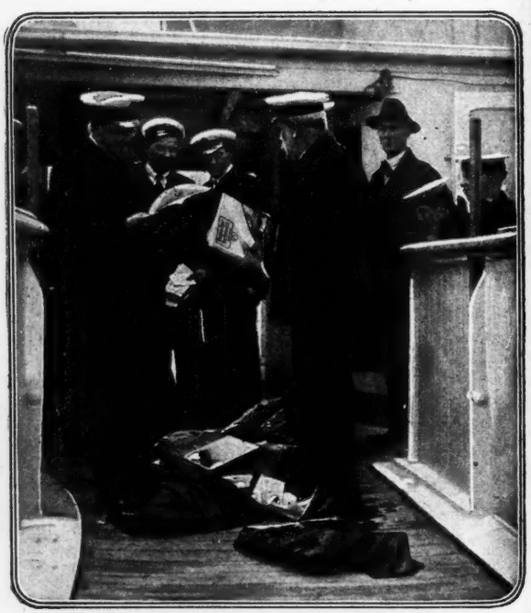
There seems to be no reason why a steamer may not be overhauled when she is as much as a day or two at sea. Late mail and manifest papers could be sent to Boston or Portland and there transferred to a flying-boat. Seventy miles an hour was the speed that Zimmermann made in the craft that he piloted. Compare this with the eighteen knots of *Adriatic* or the twenty-two or twenty-five knots of a fast turbine liner, and you see at once how wonderful are the possibilities.

It is apparent, too, that the reverse proceeding is also feasible. The time is coming when every transatlantic liner will carry her own flying-boat. The banker or the lawyer who must reach shore hours in advance of the ship, the package that should be in the hands of some business house in New York or Chicago without a moment's unnecessary delay, will be transferred by airplane. Running along on its own track on deck, after the plan adopted by the United States Navy on its battleships, the flying-boat vaults into the air and speeds on, landing its passenger and its little bundle of freight five, ten, even twelve hours in advance of the ship itself.

Day of Transatlantic Airplane Near?

A far-seeing newspaper woman, who watched from a yacht at sea, the experiment of dropping mail upon the *Adriatic* made the comment that it was all very like overtaking an oxcart with an automobile. Isn't the overhauling of a steamship by a swift airplane soon to become obsolete?

The steamship will continue to plow the waters of the seven seas, if only because it is the cheapest carrier of bulk freight ever invented. It was the object of the POPULAR SCIENCE MONTHLY'S experiment to prove that the airplane can be made a useful adjunct of the steamer, and that object was attained when the first bag of mail was delivered to the *Adriatic* at sea long after she had left her pier.

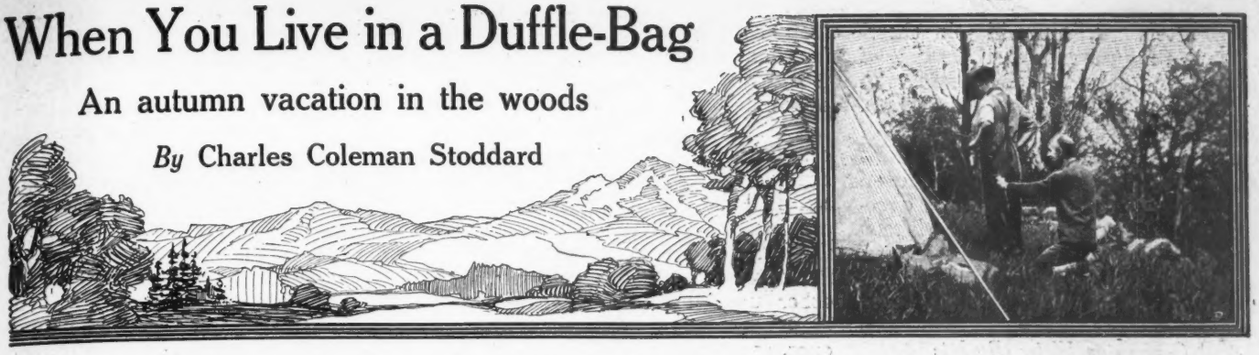


The bag was hauled up to the bridge of the *Adriatic*, and Captain Ranson distributed copies of the POPULAR SCIENCE MONTHLY that had been delivered to him by flying-boat

When You Live in a Duffle-Bag

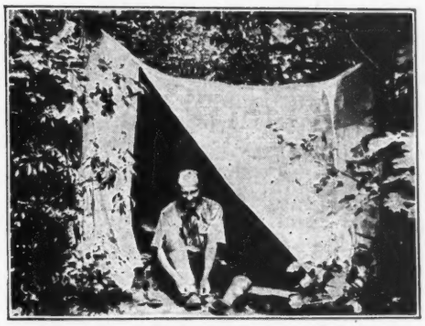
An autumn vacation in the woods

By Charles Coleman Stoddard



THE other day, when I was sewing up Joe's pants behind the tent, I was reminded that I had carried a sewing-kit in the old camping outfit for more than two years without using it. Oftentimes it seemed a nuisance, and I was tempted to throw it out; and yet it is just these little things, useful only in such an emergency, that save a situation—perhaps a life—or unexpectedly add to our comfort in the woods.

Of course, the prime purpose of camping out is to rid ourselves of many of the so-called "luxuries" of our conventionalized modern life. But this does not mean that one must live in camp like a cave man, or deny himself certain creature comforts that even the savage provides for himself within his knowledge.



Mosquito netting attached to the tent will enable you to sleep comfortably

What Is Indispensable?

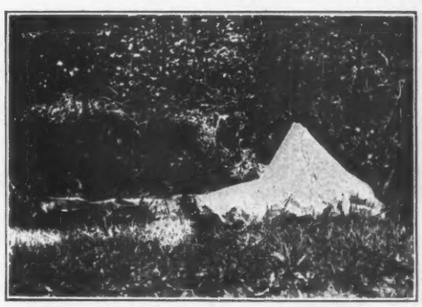
It is presupposed that we will provide ourselves with tents, or other shelter; that we carry with us blankets and a waterproof ground-cloth or poncho, or other sleeping equipment; that we have a cooking outfit and proper food. Clothing will vary with the locality and the season of the year; if we are to hunt or fish, arsenal and tackle must be put in order, and pack-straps, packs and duffle-bags made ready.

The question now arises, what is indispensable? Not how much do we want to take, but how much can we afford to leave behind?

When we sit down to the contemplation of the almost endless array of articles offered in the catalogs of dealers the task seems impossible. Be sure that before you have finished, you will buy most of these things. Many of them you will discard forever; but from them, and from your own improvisations, you will gradually sift out a selection of things that you will always pack or carry—the little things that make up the individuality of the camper, and make camps to differ one from another.

For instance, a few yards of mosquito netting, if your tent is not already screened. It costs little, weighs next to nothing, and occupies very little room in the pack. It is worth your whole outfit on a night when the unspeakable little nuisances are abroad. It also insures one of comforting and restful sleep in the early morning when flies are likely to be troublesome. If we use cheesecloth or tarlatan, rather than ordinary cloth mosquito netting, it will keep out even the smallest insects, and we can have a light in the tent—never a safe experiment without such protection. But, even then, be certain that all the openings are tightly closed unless you crave company. The illustration shows three lengths of double width material rigged to the fly of our baker tent with ordinary safety pins. The edges are rolled once together and pinned making a tight seam. The bottom is tucked back under the ground-cloth, or held down with small flat stones, and a single seam is left open for entrance.

If you choose to sleep without a tent, as you will often wish to do in the mosquito season—and one really has not tasted the outdoor life at its finest until he has rolled up alone under the stars—it is not necessary to swelter and to breathe foul air by covering up head and arms with the blanket, and then securing only doubtful protection. Set up two crotched sticks about eighteen inches high, one each side of the bag or blanket, about eighteen inches from the head of the bed; and across these, supported by the crotches, lay a straight stick. None of these need be thicker than the finger; but the two side sticks should be set firmly in the ground and all the ends carefully smoothed with a knife, so that they will not catch in the meshes of the net and tear it. Place one end of the net smoothly on the ground, extending for about a foot under the head of the bed or mattress; and, after you have crept in, draw the net up over the frame, letting the foot fall across the blankets—then tuck in the sides. You may hear the marauders making merry outside, but you may rest in peace with the assurance that none will be able to reach you.



Sleeping without a tent in mosquito time isn't so bad if you do it this way

'Ware Damp Matches

Probably, along with a compass and a good axe, the most necessary thing to carry into the woods is a practical, waterproof match-box. A single misstep on a slippery log may tumble you into the water; or, if you have tramped all day in the rain, soaked to the skin, a dry match means a good fire, comfort and perhaps your life. A tightly-corked small bottle serves the purpose admirably; or, better, a brass shotgun shell that can be corked tightly, for there is no danger of that breaking in your pocket. Either of these will do in an emergency. Several practical containers are on the market that will stand immersion for hours, even days. All have their good points; you may suit your fancy. My choice is one of black gutta-percha with a screw top and a soft rubber gasket. It is light and serviceable and has an added advantage in that it will float if dropped overboard, where a metal box would sink. Always, too, carry a liberal supply of matches in the pack, in a push-top tin or other watertight container, for a damp day or two in a camp is almost as fatal to matches as actual contact with water.

A folding candle lantern — which weighs little and slips conveniently into the pack or pocket, and is always ready — with plenty of candles, will furnish safe, sane and adequate light. If you ever have attempted to pack kerosene into camp, and have been forced to eat food flavored with it for

days afterward, you will join cheerfully in the praises from thousands of outers who swear by this simple and most useful of camping contrivances. In it you can use any and all sizes of candles, and candles can be bought anywhere. It will not blow out, even in a gale. It can be dropped, overturned and knocked about without danger, and when folded will not grease or smudge off, or damage the clothing or the contents of the pack.

Concerning Water Buckets

My special thanks go out to the man who conceived the collapsible canvas

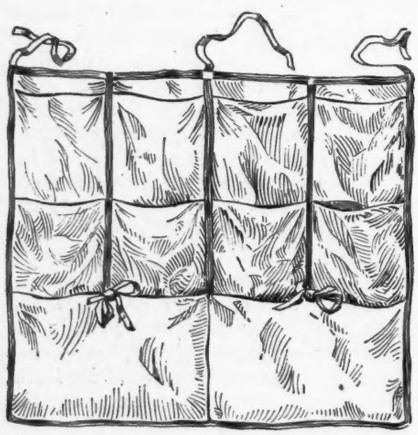
What is vacationing without a canoe? Every camp should have one or more

water bucket. Often water must be carried some distance into camp, and it is always convenient to have a quantity near the cook fire. The cooking pots are too small, and usually in use, and if one is packing his camp on his back he cannot be burdened with the size and weight of a large utensil. These buckets are simply heavy, waterproofed canvas bags, similar to the feed-bags used for horses, with a round bottom, a wire hoop at the top, and a rope handle. The capacity is approximately three gallons. Collapsed, they are not much larger than a pie-plate, and two of them (dried out) weigh scarcely more than a pound. They also come with a canvas throat that ties at the top to prevent slopping, for canoeists and for carrying water for some distance, and, for autoists, with a spout. For ordinary purposes, however, the open buckets are more convenient. These buckets have another excellent point, in that they automatically keep the water cool by slow evaporation. If the outside is kept wet (and usually the weight of the water inside will slowly force a small amount through the canvas) and the bucket is hung in a moving current of air, a cool drink is assured.

The Culinary Department

Two dish-towels and a dish-mop will be appreciated by the cook. It is all very well to romance about scrubbing greasy tinware with sand and cold water, but a pot of hot water on the back of the fire, soap and a mop, and a good dry cloth are better. Get a big, soft mop. If the handle is too long, cut it off to about four inches. A hole through the end of the handle, with a loop of string tied through it, is handy for hanging the mop on a bush or tree to dry out. A combination can-opener and corkscrew, with an arrangement for opening capped bottles, is convenient. Or you may carry an Army or Boy Scout knife, which combines all these with a stout jack-knife and can be carried in the pocket. A flapjack turner is indispensable for frying potatoes, serving eggs, and many other uses that its name does not imply. Get one of the convenient ones, consisting only of a broad blade, slotted at one end, which can be slipped on the blade of a cooking knife for a handle; or if you have one of the ordinary kind, with a long wire handle, cut off the handle within about two inches of the blade and improvise a handle by using a split stick when you are in the woods.

In the kitchen the problem of keeping one's hands clean while cooking is not a serious one, but there one is not handling firewood, sometimes charred, and well smoked pots, and water is always handy for washing. Over the camp fire, the best protection is a pair of ordinary cotton work gloves. Slip them on, after you have washed your hands, while working around the fire, and lay them aside when handling the food. They also serve as pot-lifters and protect the knuckles from the direct heat of the fire and will be found convenient when doing other rough work around camp. Always put an

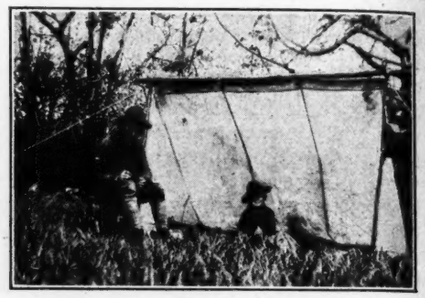


A bag similar to that one which carries old shoes will come in mighty handy

old newspaper or two into the pack—not to read:—God forbid! There are too many things in the woods to interest one to find time for that—but newspapers can be put to so many practical uses around camp. And always hoard all the paper bags and other wrappings for packing when coming out. Burn all that you do not use before putting out your fire on breaking camp.

An excellent way of keeping together the little things is a glorified form of the old "shoe-bag" that used to hang on the closet door. This consists of an assortment of conveniently arranged pockets, made of khaki, ticking, or some other strong, light-weight material, with tapes at the top, by means of which it may be suspended from a tree limb, from crotched sticks, or to the wall of the tent. In these pockets are carried all the small articles of personal outfit and other little things likely to be easily lost. When we need them, they are conveniently near at hand, and when we have used them, back they go.

In packing, the whole bag is rolled together inside the blankets, or tied up and thrust into a corner of the pack-bag, and we can be morally certain that nothing is left behind. This bag can be made at home at the expense of a few cents.



This lean-to tent shields you from the sun and acts as a wind-break

All soiled clothes should be washed out immediately, dried and folded neatly—not jammed "any old way" into the pack.

Perhaps there is no better way to illustrate the usefulness of this bag than to give an inventory, exclusive of some of the articles already mentioned, on a recent trip.

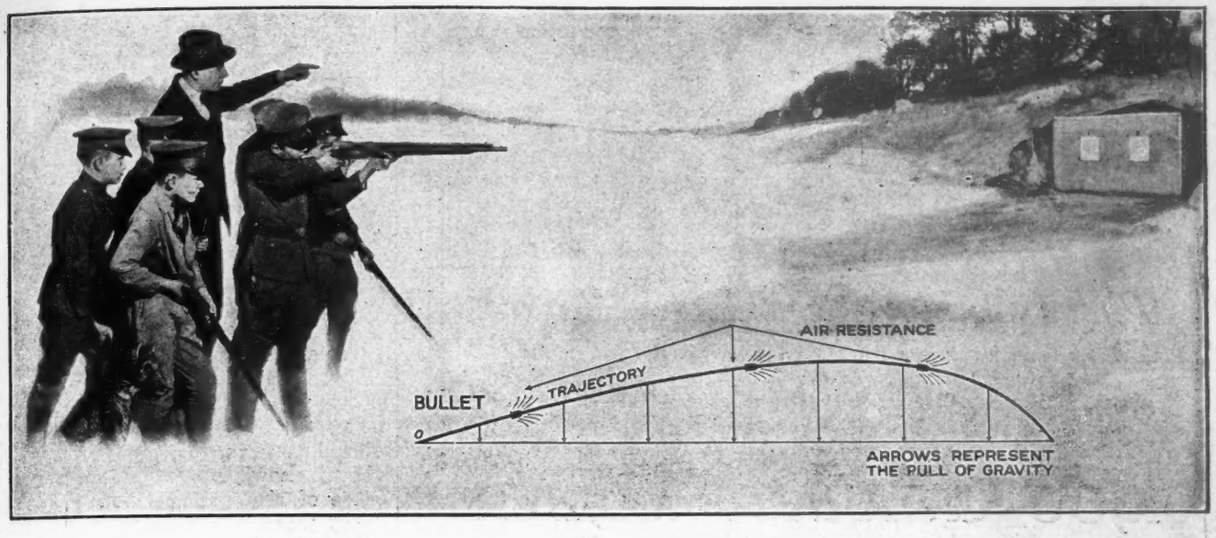
In the small pockets: tooth brush and powder, comb, towels, soap, shaving outfit and mirror; a small note book and pencil, and a few stamped postcards (the latter are always worth while, for stamps and envelopes are useless in camp, as the dampness soon sticks them together) ; sewing and medicine kits, extra pipe and tobacco, extra spectacles, films for camera, blanket pins, safety pins, matches, paper bags, sharpening stone, rope and string, wire, a few nails, repair kit and sewing awl.

In the large pockets: extra shirt, extra pants, sweater, handkerchiefs, underwear, socks, moccasins, and extra shoestrings.

Don't Forget Your Camera

By all means carry a camera, and *plenty of films.* Any of the small folding cameras are easily packed and will take all the pictures that you will care for. But don't make the mistake of choosing too small a camera (you will not want to make enlargements of all your negatives).

Remember, too, that a camera in camp, even a cheap one, requires some attention. Take all your pictures carefully; if they are failures, they cannot be duplicated. Know your camera thoroughly before you take it into the woods—its exposures for ordinary light and shade, and its adjustments.



Tracing the flight of a bullet

Points in rifle shooting that you learn in the W. J. R. C.

Sharpshooter Medal

THE instant a bullet leaves the muzzle of a gun, gravity starts pulling it down, or making it drop.

At short, *point-blank* range, this drop is slight. In longer distances, the drop depends upon the speed of the bullets. High velocity bullets drop but little since it takes them only a tiny fraction of a second to reach their mark.

To take care of this drop, sights are fixed so that the rifle points somewhat above the bull's-eye, though the *aim* is dead straight. As a result the bullet travels in a curved path, or *trajectory*, as shown in the diagram above.

Knowing just what sight allowance to make on long shots is one of the fundamentals of shooting that boys of the Winchester Junior Rifle Corps soon learn to master.

Boys of the W.J.R.C. have a great advantage over the fellows who don't belong to any recognized rifle club. They get all the shooting instruction they need to become real experts in the use of rifles. They have competent men to teach them all the fine points of shooting.

Start a W. J. R. C. "Unit" with your friends

Why not get together with half a dozen of your chums, join the Winchester Junior Rifle Corps and organize a regular Unit which will be officially recognized by National Headquarters? When you have enough Marksmen in your Unit, you will be matched against other Units.

Any boy who gets a Unit started receives a Special Service Pin.

The W.J.R.C. will help you from start to finish in rigging up an indoor or outdoor range. It provides for officers, supervisors, and adult instructors to make your shooting safe.

It costs you nothing to join the W.J.R.C. There are no dues and no military obligations. The W.J.R.C. was organized solely to encourage better marksmanship and better sportsmanship among boys and girls of America. It is intended to develop the qualities of fair play and manliness which are essential to success in after life. Any boy or girl not over 18 and who is in good standing in his or her community is eligible.

Membership in the W.J.R.C. covers the entire United States. There is hardly a town now that has not at least a small Unit of the big National Organization where boys are learning to become expert riflemen and are competing for the famous Winchester Marksman, Sharpshooter and Expert Rifleman Medals. You, too, can earn these trophies of marksmanship if you join the W.J.R.C. and start shooting now.

Get the official plan and rule book

Write today for the Winchester Junior Rifle Corps "Plan for organizing a W.J.R.C. Unit" and for the official rule book—"How to handle a rifle safely." This booklet tells you all about the W.J.R.C. and describes in detail the fine points of shooting—alignment of sights, the three correct positions, rules for gun safety, the care of rifles, and the proper rifle for you to use.

If you are a boy scout, give your name in full, the troop you belong to and the name of the scout master.

If you are not a boy scout, state what boy organization, if any, you belong to, giving the name of the official in charge.

National Headquarters

Winchester Junior Rifle Corps

275 Winchester Ave. New Haven, Conn., U. S. A.

Division 1020

The following table gives the trajectory heights for the Winchester .22 Long Rifle Lesmok Cartridge at various ranges.

When Range is	Height of Trajectory at ¼ Range	Mid Range	¾ Range
25 yds.	0.202 in.	0.275 in.	0.203 in.
50 "	0.845 "	1.14 "	0.865 "
100 "	3.57 "	4.86 "	3.73 "
150 "	8.49 "	11.68 "	9.044 "
200 "	15.93 "	22.12 "	17.28 "
250 "	26.24 "	36.76 "	28.96 "
300 "	39.77 "	56.20 "	44.62 "

Standard types of .22 caliber Winchester Rifles, popular with members of the Winchester Junior Rifle Corps.

WINCHESTER MODEL 90. Take-down Repeating .22 caliber rifle, 24-inch octagon barrel. The standard target rifle for over 25 years.

WINCHESTER Take-down .22 caliber single shot rifle. A low priced, light weight gun made in two sizes.

WINCHESTER JUNIOR RIFLE CORPS

National Headquarters, 275 Winchester Avenue, New Haven, Conn., U. S. A.

There Once Was a Lazy Sailor

His pet aversion was washing clothes. So one day he fastened his clothes in an old net, and tied it to the stern of the moving boat. When he pulled up the net his clothes were clean. Thus we learn that it is not the rubbing of the clothes which cleanses them. It is the action of the water as it is forced through them time after time.

1900 CATARACT WASHER

THE 1900 Cataract Electric Washer is built on this principle, but it forces the hot sudsy water through the clothes in a figure 8 movement. By this magic movement the water is forced through the clothes *four times* as often as in the ordinary washer! It is the figure 8 movement that makes the 1900 Washer the *perfect* washing machine.

There are no parts to rub against the clothes, and no heavy cylinders to lift out and clean. The swinging, reversible wringer saves steps for it can be moved to any position without shifting the washer. Costs less than 2c an hour to operate and washes a tubful of clothes in 8 to 10 minutes.

1900 Washer Co., Binghamton, N. Y.

Canadian Factory and Office
Canadian 1900 Washer Co., 357 Yonge St., Toronto, Can.

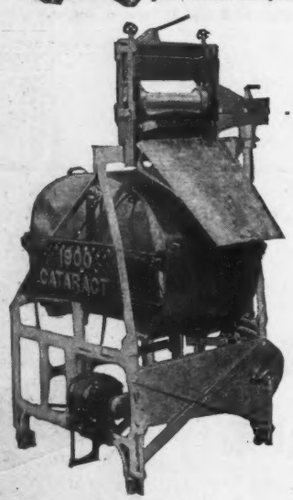
Just connect it with the electric light socket.

Even the wringer works electrically.

Your clothes are not washed with other people's.

No parts in the tub, and no heavy cylinders to lift out.

The water swirls through the tub in a figure 8 movement, and four times as often.



Come in 8 and 12 sheet sizes.

Our Trial Offer

You may prove to yourself before you buy it that the 1900 saves time, money and clothes. The 1900 dealer in your town will deliver one right to your home. After you have tried it out, you start paying for it on terms to suit your convenience.

1900 WASHER COMPANY
BINGHAMTON, N. Y.

Please send me detailed information, and the name of the nearest 1900 dealer.

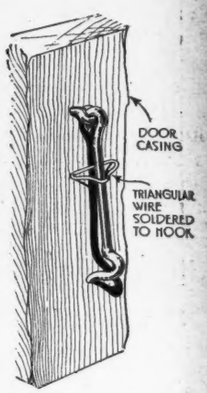
Name_____

Address_____

City and State_____

Making a Door Hook Easy to Grasp

THE common screw eye and hook, by means of which screen and storm doors are ordinarily fastened on the inside, is frequently the cause of much annoyance. The hook turns around on one side and lays flat against the casing. When it is located high in the doorway, it is often impossible to get hold of it with the gloved hand. The illustration shows how a piece of wire or sheet metal can be soldered to the hook to turn or lie flat against the doorway and it will always stick up so that it may be readily grasped with a gloved hand or in the dark.—F. W. B.

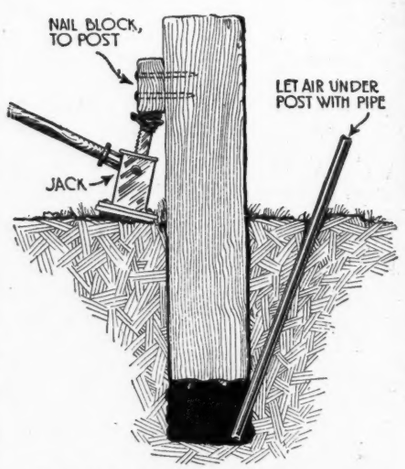


The elusive door hook is kept in position by a wire soldered to it

Give the Old Post Air to Make It Come Out Easily

MOST people who have had occasion to pull up old fence posts have undoubtedly been exasperated by the way they refuse, at times, to come out even when very loose.

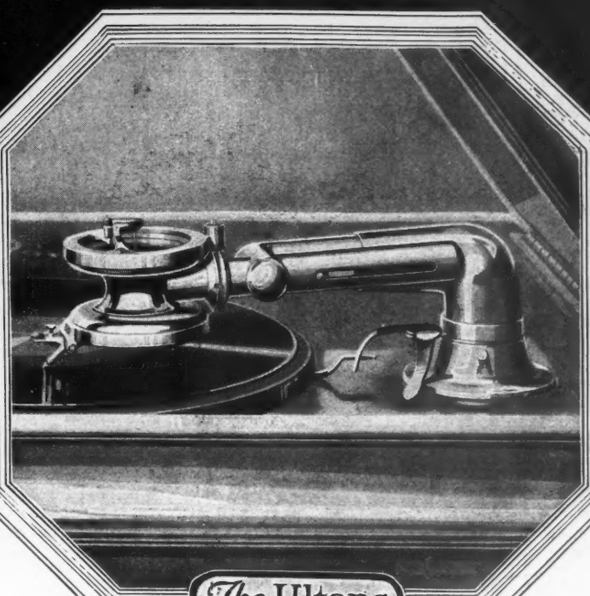
Very often this is caused by air pressure; the pole acts like a piston and the hole as the cylinder. As the pole is lifted it exhausts the air and creates a vacuum. On a post 6 in. in diameter the air pressure downward may reach 400 pounds, which readily shows why the post refuses to come out.



By letting air into the vacuum beneath the post its extraction is made possible

If such a case is encountered, drive a small iron pipe under the post, as shown in the illustration, making sure that the hole in the pipe is free so that the air may enter readily. In almost every case the post will come out without further trouble.—VICTOR H. TODD.

The BRUNSWICK
Method of Reproduction



Achieving the Ultimate in Phonograph Music

By Means of Two Exclusive and Scientific Features

The Brunswick Method of Reproduction gained instant and wide-spread public favor because it enriches the tone qualities of all records. For this alone it is adored by artists and approved by the hypercritical. It embodies the true principles of tone reproduction and complies with the established laws of acoustics in projecting tone. Two revolutionary factors, among others essentially different from other phonographs, make this possible. They are the Ultona and the Tone Amplifier.

The Ultona Plays All Records

The Ultona—a product of creative genius—enables one to play all make records on the Brunswick. Not a combination contrivance nor complex mechanism, yet involving a fundamental principle of sound. By a slight turn of the hand it supplies the proper needle, correct weight and precise diaphragm.

The Amplifier Enriches Tones

As the name implies it amplifies tone, making it truer and sweeter. It is a vibrant tone chamber like the sounding board of a fine piano or violin. Constructed entirely of moulded hollywood and free from metal it gives the requisite resiliency for unfolding and projecting true tone.

Ask to Hear The Brunswick

Any Brunswick dealer will be glad to demonstrate the many claims made for it. Choose your favorite record to be tested—the one that will help you judge best. Your verdict like that of unnumbered thousands will be "the one super phonograph."

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I have shown you a few proofs of my versatility in the various types above. You will agree that no other typewriter *can* do what I do. Therefore, write today for the story of all the wonders I perform.

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Farm Sewage and Its Disposal

By L. B. Robbins

PROBABLY no subject is so important in farm life and life in rural communities generally, or so lightly regarded, as proper sanitation and disposal of sewage.

Thousands of farmers allow the sewage from sink and closets to flow either directly upon the land adjoining the dwelling, or into a nearby stream, before removing the poisonous contents or making any attempt to reduce it to a negligible quantity.

Then, perhaps, they wonder why a sudden typhoid epidemic runs a riotous course through their family, possibly carrying off some of their loved ones.

Here's a good way to keep down doctor bills and prevent sickness

The writer has visited scores of farms and watched sewage trickle from the house through soggy wooden troughs to a slimy, dirty pool somewhere in the garden patch and not too far from the well or pump.

Such cases are not isolated; they are occurring every day all about us with apparently no thought as to what the results may be.

The usual precautions in disposing of such wastes are all right as far as they go but even with cisterns, deep sump holes and catch basins there always remains a certain amount of putrid matter at the bottom which it is dangerous to neglect.

The drawing illustrates both the principle of construction, and a design, for a small septic tank for the ordinary farm. It presents a side sectional view from which the method of operation will probably be readily understood.

Sections *A* and *B* compose two parts of a concrete box about 8 ft. long by 3 ft. deep by 3 ft. wide. The partition *D* may be of concrete or wood. Wood can be easier removed if the tank needs cleaning, but of course is subject to rotting.

The sewer pipe *C*, from the house, should be turned down by an elbow and discharge about midway between the top and bottom of the tank to prevent disturbing the scum which floats on the top.

Provide partition *D* with a series of holes, placed as shown, about on a level with the pipe *C*. This allows the passage of the contents from *A* to *B* with the minimum amount of disturbance. The horizontal baffle plate *I* further protects the scum from the action of currents.

Tip up the discharge pipe *E* at an angle so the elbow stands at the same level as the contents of the tanks. Thus the action of the discharge water is kept below the surface level.

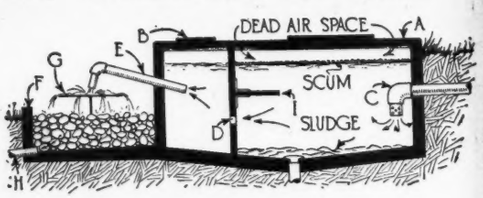
Section *F* is an open concrete box filled with stones. The floor should be slanted slightly towards the outer end so the water will be carried out by the outlet pipe *H*.

In the center of the box erect a sheet iron baffle-plate *G* on a spindle. This catches the water on its exit from the tank and spreads it to the air to aerate it.

Run the discharge pipe *H* as far from the tank as is necessary to distribute the water evenly over the land.

Tiling, laid with open joints, will aid in the effective distribution of the fluid.

Both sections of the tank should be provided with openings and tight-fitting covers for cleaning when necessary. Leave a small vent in each cover to carry off surplus gases in case of pressure during warm weather.



Showing in detail the construction of the tank and what takes place inside it

The tank top can be constructed of either reinforced concrete, or of wood, as the builder chooses. If built of the latter see that it fits tight with no cracks through which dirt may fall and disturb the scum.

Old Automobile Tires Aid in Moving Barrels

A PAIR of old automobile casings that were too worn to be of further use on the car were filled with rags, laced shut, and used in a shipping department to aid in moving heavy barrels of oil and other liquids.

Two strap-irons were attached by cutting through the heel of the casings, one being fastened permanently to both tires and the other at only one end. The barrel was then set on end, one tire placed over it, and then turned over. The other tire was put on and the free end of the strap-iron hooked into the slit cut in the other tire. The barrel was then turned over on its side and easily moved.

This not only made it easy to move the heaviest barrels, but they rolled in a straight line and made no noise. When the barrel was stored, it was set on end, the iron unhooked, the tires removed.—DALE VAN HORN.

Farming Utah takes a lesson from agricultural Iowa

SAID seasoned Iowa, as Utah listened eagerly: "I'm a farmer through and through and mighty glad to meet another. You see I feel I've got a right to real Iowan pride. For Uncle Sam has declared to me, 'Iowa, among my 48 states you take the blue ribbon for farms and farming wealth.' Light up this friendly Owl."

Utah puffed away and made reply: "Iowa, we young farmers are always glad to learn from veterans like you. Already we have irrigated nearly 2,000,000 of our fruitful acres. We raise fine crops you must admit. Surely you have used beet sugar from our great refineries."

o o o

Far-flung States always find friendly get-together in Owls and White Owls. For these dependable Cigars are high favorites all over this good old U. S. A. Dependable fragrance is the reason. Guaranteed dependable by the General Cigar Co., Inc., and their nearly $3,000,000 Owl leaf reserve.

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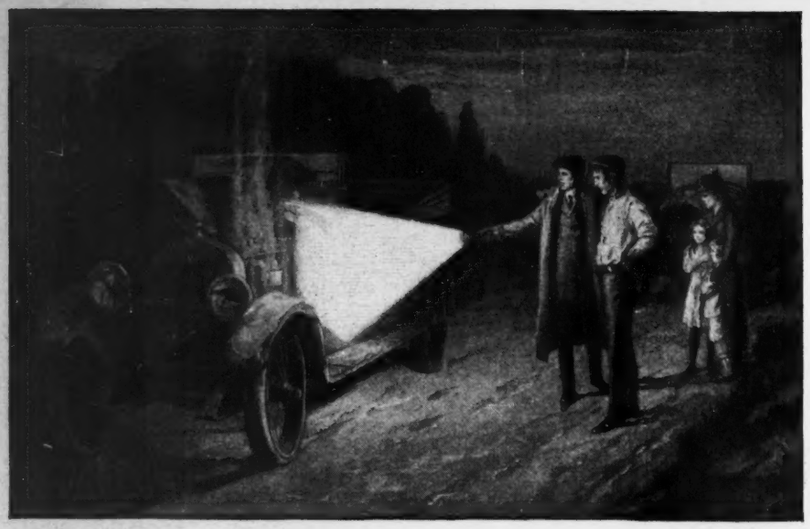
OWL 7c | white OWL 8c



"Daylo Would Have Prevented This!"

—"if only you'd used a Daylo to hunt down that trouble under the hood, this wouldn't have happened."

Of all the foolish uses of matches—and they are legion—none is quite so dangerous as around your automobile.

On the road or in the garage, whenever light is required around the engine or inside the tonneau—when tires must be changed, side curtains fixed, or a signpost read in the dark, Daylo is the absolutely safe light. You can safely hunt even a gasoline leak with a Daylo.

Stop taking risks with *your* car; get a Daylo now—you will want it with you wherever you go.

Look for the Daylo "Safety First" medal design in the dealer's window; he will have the right Daylo for you.

AMERICAN EVER READY WORKS
OF NATIONAL CARBON COMPANY
Long Island City New York
In Canada:—Canadian National Carbon Co., Limited, Toronto

Accept no substitute; ask for the genuine Ever-Ready Daylo or the long-lived, brighter-burning Tungsten Battery.

Indoor Toilet
Convenient – Sanitary

The Comfort Closet for Homes, Summer Cottages and Camps. Entirely odorless. Scientifically ventilated. Strong chemicals dissolve contents; kills all germs. Easily installed. Convenient to move. Contents disposed of easily as garbage. **Prevents fly breeding** and water contamination. Provides sanitary, odorless toilet in home protected from cold and stormy weather. Only closet with porcelain container. Easily cleaned. Approved by U S. Health Bureau. 30 Days' Free Trial. **Agents make $60 to $100 weekly.** Exclusive territory. Ask for booklet—FREE.
Comfort Chemical Closet Co., 1330 Factories Bldg., Toledo, O.

HERE'S YOUR CHANCE
This 5 Passenger, 4 cylinder, 37 H. P. BUSH Car—Timken Bearings—Willard Batteries—2 Unit Starting & Lig.—116-inch wbl. base. Write at once for the best Automobile Offer in existence—Don't wait—Cars guaranteed or money back.
BUSH Address J. H. Bush, President. Dept. M.-111 MOTOR CO., Bush Temple, Chicago, Illinois

HIGH SCHOOL PUPILS
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Faultless
SINCE 1881
"The NIGHTwear of a Nation."
Exceeds Expectations
Recommended by 11886 Dealers
E. ROSENFELD & CO. BALTIMORE, NEW YORK.

A Trousers-Hanger Used to Display Magazines

ALIVE newsdealer discovered a novel way to display interesting illustrations in a magazine, by which to attract customers by, suspending it from a post or other convenient point with the aid of a skirt or trousers hanger.

He simply clipped the two spring

Skirt- and trousers-hangers can be used to good advantage in this manner

jaws of the hanger to opposite sides of the periodical and hung it by a cord at a height at which those passing by could read.—L. B. ROBBINS.

How Short Circuits Occur on an Automobile

AUTOMOBILE owners will do well to note the following and to do a little examining on their own account, if they are not getting the power from the engine that they should.

Our machine which had been running excellently, gradually began to lose power when the load was thrown on. It would run all right when standing in the garage, but when taken out on the road it lost power. A new carburetor was attached, which did no good. The spark plugs were tested and seemed to be in good order, and the spark was always in evidence. The machine was taken to a local garage and the mechanics did their best but all to no good. New cylinder rings were put on without success.

Finally it was suggested that new wiring be run all through. This was done—albeit rather sceptically—and sure enough the engine promptly put forth its original power.

The trouble was caused by the wires getting heated and becoming impregnated with oil until the insulation had become porous, thus the trouble did not appear until the car was on the road, when the jolting caused the imperfections to disclose themselves. The wiring had been tested several times, but did not show any signs of being faulty.

The best plan is to carefully examine the insulation, and if it is the least bit soft put in new wiring. It is cheaper than new carburetors or piston rings.—ALBERT E. JONES.

Why does every Barber use this type of Razor?

Because while you might shave your own self with a razor that pulls and scrapes, you won't stand for a barber shaving you with a dull razor.

A barber has to have a razor so sharp that it will shave you without pulling. He must use a blade whose keen edge can be restored again and again with a few easy strokes on the strop.

Anybody Can Strop a GENCO Razor

Every GENCO blade is ground concave; its back is broad; and its edge is supported by the required bevel. These features compel a GENCO blade to meet the strop at the right angle to restore the best of shaving edges with a few easy strokes.

And that edge on a professional blade—how quickly and smoothly it does its work! It's the edge that every barber finds he must have.

The Safege is a regular razor with a guard. Flip back the guard, and its blade can be stropped sharp as easily as the other.

You undoubtedly have seen many Genco Razor advertisements. Why not go to your dealer and see the razor? If you cannot conveniently secure Genco Razors in your locality, we will see that you are supplied.

Remember our guarantee, "Genco Razors must make good or we will."

Geneva Cutlery Corporation

47 Gates Avenue **Geneva, N. Y.**

Largest Exclusive Manufacturers of High-Grade Razors in the World

Have you ever stropped a blade scientifically designed to strop—a blade made with a broad, firm back, hollow ground, and swelling into a slight bulge to give back-bone to the edge? This blade can be stropped by you as easily as by your barber. The blade meets the strop at just the correct angle to assure a perfect shaving edge.

"Neither lender nor borrower be", —hold fast to *your* ELDORADO. But have you found *your*

DIXON'S ELDORADO
the master drawing pencil

—the pencil that makes your fingers feel fit and puts a pleasant pep in your pencil work?

Our pencilogue "Finding *your* Pencil" tells you how to find it: a free copy to everyone who wants to ease and quicken his pencil work. Write for it today. And if you wish samples worth double the money, enclose 15c, stating the work you do.

Joseph Dixon Crucible Co.
Pencil Dept. 120J Jersey City, N.J.
Canadian Distributors
A.R. Mac Dougall & Co., Ltd. Toronto

There's a Dixon-quality Pencil, Crayon and Eraser for every purpose.

HB BATTERY CHARGING PAYS BIG PROFITS

GET BIG PROFITS THIS FALL
$100 to $200 CLEAR EVERY MONTH

Fall brings big demand for reliable HB Battery service. Get your HB 600 watt Charger NOW. Recharges 1 to 8 6-volt batteries. Cost 10c to 15c each, customer pays 75c to $1.50. No repairs, no burn outs or expensive renewals—steady, reliable service. Easy to install and operate, no mechanical knowledge required.

Small Cash Payment Puts This Money-Maker in Your Shop

Balance on easy monthly terms. Profits easily carry payments. Absolute Money-Back Guarantee. Start NOW to build *your own* big, permanent, profitable business. We help you. Tear out this ad and mail TODAY for information.

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Successful Manufacturers since 1893

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200 Fifth Avenue Dept. S New York

Uses for Empty Carbide Cans

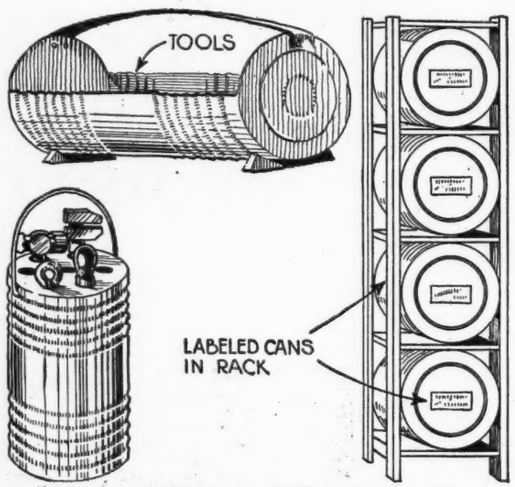
By David Baxter

EMPTY carbide cans may be employed for quite a number of different things that are convenient to have about the garage or shop. The garage or repair shop possessing an oxyacetylene welding plant will find the empty cans especially useful.

They are well made and air-tight, and of strong material.

They may be made into a convenient moisture-proof, dust-proof cupboard for storing material and supplies which require to be kept dry and clean, such as chemicals, gasket material, bolts, welder's metal, flux powders, and so on. The air-tight lid of the can effectually prevents any moisture or dirt from entering its interior.

The can lids may be fastened to a part of the rack with a chain or wire. This is not necessary, however, if the mechanic makes it a rule to keep the can closed at all times. The lids should have labels pasted on them stating the kind, quantity, or other information concerning the contents of each can. This saves a deal of time, as the desired information can be had at a glance, and it prevents trouble due to selecting wrong materials.



These are only some of the uses for old carbide cans. What can *you* do with them?

The accompanying sketch will assist in the construction of a carbide can cupboard. No measurements or specifications are given here as this is a matter of individual choice. The style and size of the cupboard may be varied to suit conditions. The cans may be placed in one, two, or more tiers of any desired number. The drawing shows one tier, six cans high, which is very convenient. It occupies small floor space, and will fit behind a door or in an odd corner.

Any rough lumber may be employed to construct the frame-work, with braces and cross pieces, upon which the cans rest. There should be cross pieces in front and behind the cans to keep them rigid. A rough but substantial rack can be made in an hour or so of spare time. Of course if the maker is more particular he may use better lumber and give the whole thing a coat of paint, or he may make it fire-proof by using metal angle bars welded together.

Another use for empty carbide cans is to convert them into tool-boxes or containers for the storing of nails, screws, washers, wrenches, small tools, etc. Two styles are shown in the accompanying drawings, and others may be made to suit the individual ideas.

One is made by cutting the can in half along each side, keeping the ends intact. To these handles are fastened. Wooden legs are nailed to the bottoms or metal legs are easily made if preferred. This is a handy device for such tools as wrenches, hammers, chisels, and other tools in constant use.

The other style is for tongs, scrapers, clamps, pokers, etc. It is made by cutting several different sized holes in the end of a can to receive the handles of the different tools. This arrangement keeps the tools always in sight, so that they may be selected instantly. An iron bail is fastened to the container so that it may be carried about from place to place as needed. One each of these tool-boxes gets rid of two empty carbide cans.

Still another way to make use of empty carbide cans is to employ them for shipping delicate repairs. A carbide can weighs little, if any, more than a strong wooden box or crate, so that the freight cost is the same. The many advantages of a can over a common crate should recommend its use in preference. It is moisture-proof and may stand on a country depot platform in the rain without harm to the contents. Its construction prevents it from being smashed in the usual handling of freight or express. The size and shape make it a convenient package to handle and store. The nature of the lid dispenses with all nails, wire, etc., making packing an easier and shorter process.

Small articles, such as small web gearing, carburetors, manifolds and other fragile parts of automobiles can be shipped in safety. The carbide can is filled with excelsior or straw, the article being bedded in the packing material. Jugs or bottles of oil and other liquids can be shipped in these containers when the haul is short.

The foregoing are only a few of the many uses for empty carbide cans.

Blue Buckle OverAlls

Union Made

"Strong-for-work"

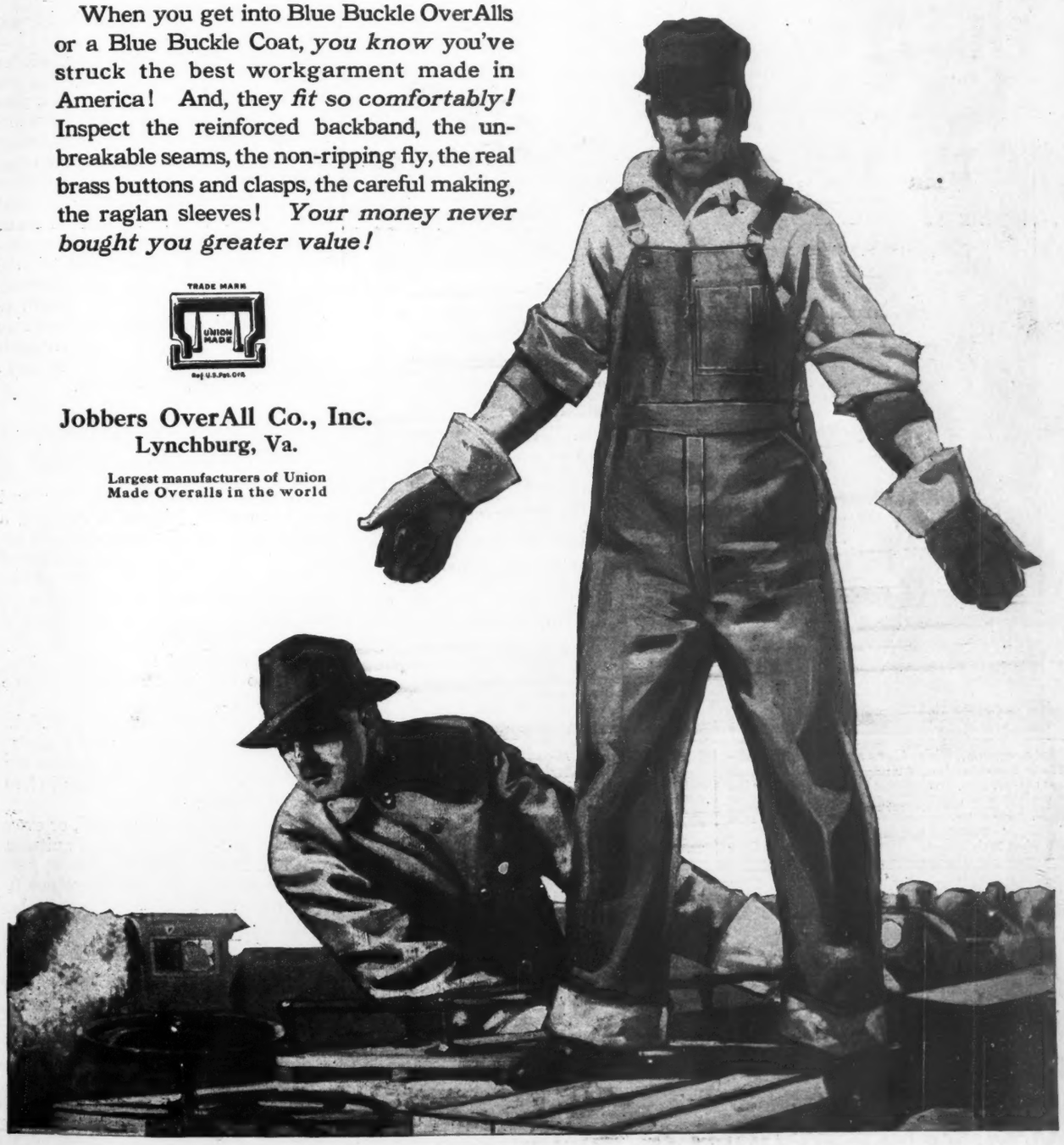
ALL the joyous satisfaction of "doing-a-job" in comfort is yours when you're togged up in big, generously oversize Blue Buckle OverAlls. They're made to meet every wish any man can make for a perfect work-rig! *They're right* in quality of denim, fit and workmanship! They give long, true service under the most exacting conditions

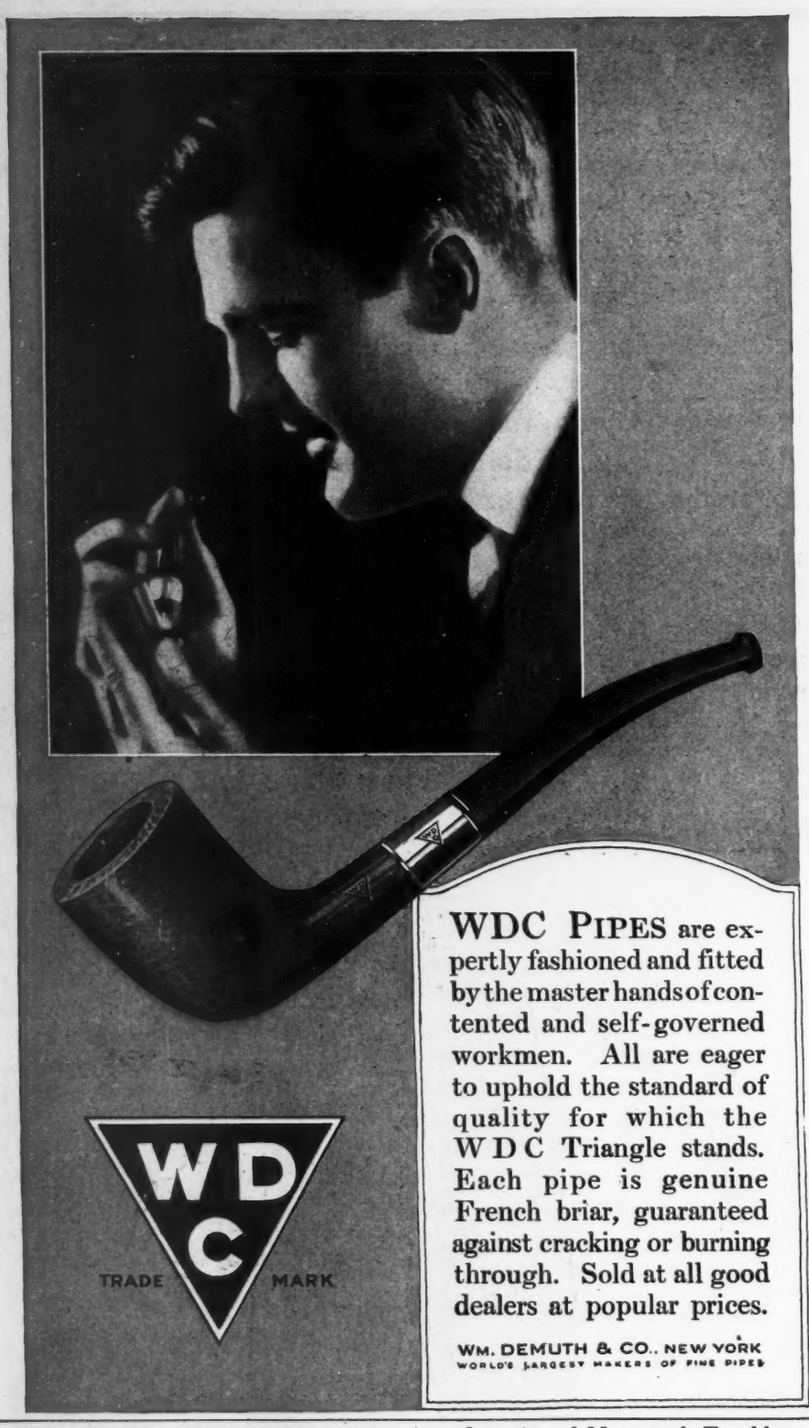
When you get into Blue Buckle OverAlls or a Blue Buckle Coat, *you know* you've struck the best workgarment made in America! And, they *fit so comfortably!* Inspect the reinforced backband, the unbreakable seams, the non-ripping fly, the real brass buttons and clasps, the careful making, the raglan sleeves! *Your money never bought you greater value!*

TRADE MARK
UNION MADE
Reg. U.S. Pat. Off.

Jobbers OverAll Co., Inc.
Lynchburg, Va.

Largest manufacturers of Union Made Overalls in the world





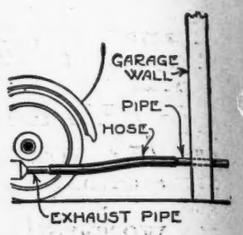
WDC PIPES are expertly fashioned and fitted by the master hands of contented and self-governed workmen. All are eager to uphold the standard of quality for which the W D C Triangle stands. Each pipe is genuine French briar, guaranteed against cracking or burning through. Sold at all good dealers at popular prices.

WM. DEMUTH & CO., NEW YORK
WORLD'S LARGEST MAKERS OF FINE PIPES

Never Breathe the Exhaust Gases of an Automobile

WHEN Nat Wills, the noted actor, was found lying beneath his car, dead, and it was found that his death had resulted from inhaling the exhaust gases of an automobile, the motoring public began to take precautions against this menace.

If one should remain for five minutes in a small unventilated garage, with the door shut and fumes pouring from the car's exhaust he would be beyond the doctor's aid.



The hose carries the deadly fumes to the outside air and keeps the garage air pure

If you must work on the car with the engine running attach a hose to the exhaust and run the hose into a pipe that communicates with the outer air. In this way you get rid of those deadly fumes and eliminate the danger of being suffocated by them.

It is very simple to arrange so that this can be done. A hole is made in the wall of the garage, in a convenient position to the rear of the car, and piece of gas-pipe inserted. This should be of sufficient length to protrude about 6 or 8 in. on each side of the wall and, if the wall is wood, duly insulated, Connection is made with a hose.—E. T. OFELDT.

Improving the Handsaw with Additional Teeth

A DEVICE much used by our local carpenters, instead of carrying a special nail saw to negotiate nails encountered in repair work, consists of forming what may be termed an emergency hacksaw, by cutting, on the back of their regular saw, for a space of six inches or more, commencing at the point, a series of fine teeth, about sixteen to the inch, as shown in the sketch.

These are better cut with straight faces, and square across, like a miniature ripsaw tooth, as they bite into the metal better, and wear longer before needing refiling.

When you encounter a nail, or even a piece of gas-pipe, instead of quitting work and hunting for a nail-saw, just turn your wood-saw over and cut it through with the fine teeth on the back. As soon as the nail is vanquished, just reverse the saw again to its normal position and continue the work.—CHARLES A. PEASE.

Teeth on the top end of the handsaw do away with an additional nail saw

Motorcycles, Side Cars and Cyclecars—Their Construction, Management and Repair

By Victor W. Page. Describes fully all leading types of machines, their design, construction, maintenance, operation and repair. 550 pages 350 specially made illustrations, 5 folding plates. New edition. PRICE, $2.00

POPULAR SCIENCE MONTHLY
225 West 39th Street New York City

Location of Motorcycle Troubles Made Easy

This chart simplifies location of all power plant troubles and will prove of value to all who have to do with the operation, repair or sale of motorcycles. No details omitted. Size 30x 20 inches. PRICE, 25 CENTS

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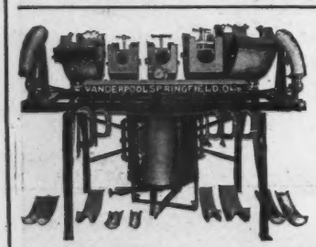
Enormous Income from Insignificant Investment



Vanderpool Vulcanizer (5 Cavity) has capacity of $100 worth of work a day. We are the pioneers in the manufacture of the Dry Cure Vulcanizer—the only vulcanizer that guarantees absolutely PERFECT work. Open a Tire Repairing Shop. Business pours in. No experience necessary. We give you free instruction. Write for FREE TIRE REPAIRING MANUAL and full particulars. If others can be successful, so can you be. Write today.

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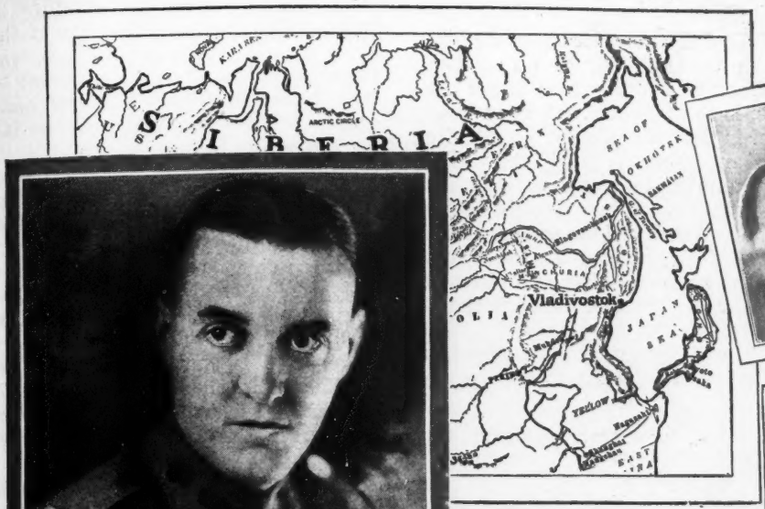

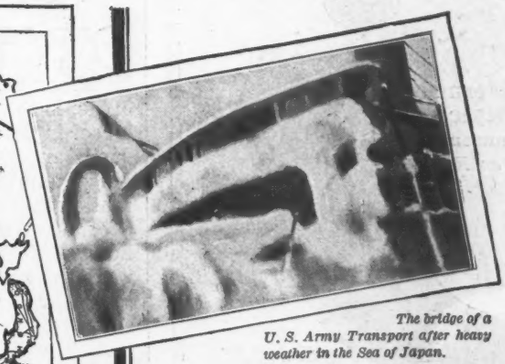

The bridge of a U. S. Army Transport after heavy weather in the Sea of Japan.

The occupants of Czech and American troop trains exchange amenities.

Czech soldiers waiting to entrain at the Vladivostok Station.

An American regiment marching down the main street of Vladivostok.

Around the World with Kenneth L. Roberts

MAGAZINE readers are familiar with Captain Roberts' splendid work and will be interested to know he is a staunch Coronatypist. Here are some of the things he says about Corona:

". . . I bought a Corona and dropped it into my kit bag and went where I was going. That . . . was a year and a half ago . . . I hammered it and hammered it and hammered it, but not once did it weaken under the strain. I dropped it into my kit bag and went back home . . . When I was ordered to Siberia with the Military Intelligence Section of our Expeditionary Force, I packed my Corona in my bag and took it along. I hammered it day after day on the train. I hammered it day after day on the transport crossing the Pacific. It stood up nobly under the rigors of the Siberian winter . . . It went to Japan with me, to the Philippines, to Guam, to Hawaii and back home again—busy every day. In the year and a half I have had it I have written well over SIX HUNDRED THOUSAND WORDS on it—Intelligence reports, correspondence, diary, verse, fiction and magazine articles..."

No one else gives the writing machine the hard usage it gets at the hands of writers and correspondents. Captain Roberts' experience is typical. Corona does stand the racket.

Corona is something besides a mere writing machine, because of its compactness, lightness and portability. Pick it up with one hand, tuck it under your arm and go off by yourself with it—in chamber, den or study, where you won't be disturbed. Or, fold it up and put it in its handy case; take it to China or Cuba or Buenos Ayres or the North Pole. It typewrites anywhere.

Price Fifty Dollars, with Handy Carrying Case

Ask our local Agent to show you Corona, or send to us for booklet

CORONA TYPEWRITER COMPANY, INC.
GROTON, NEW YORK
Branches or Agencies in Principal Cities all over the World

CORONA

The Personal Writing Machine

Corona weighs but a trifle more than 6 pounds; folds up snugly when not busy; travels where you travel, serves you on the instant. Ruggedly built, simple to operate, always handy, never obtrusive.

$50, with carrying case.

-fold it up-take it with you-typewrite anywhere

IT wasn't so much the *wear* of their Army shoes that made the conspicuous success of the American soldiers' footwear in Europe. It was their natural *fit* and their incomparable *comfort.*

The Herman Shoe Company made hundreds of thousands of pairs of those Army shoes. We make *millions* of pairs of *civilian* styles on the same Munson U. S. Army lasts.

These shapely civilianized military shoes—built of the best leathers obtainable and with the best of New England workmanship—are recognized everywhere as automatically perfect.

Sold in 8,000 retail stores. If you are not near one, we will fit you correctly and quickly through our MAIL ORDER DEPT at Boston

JOS. M. HERMAN SHOE CO.
802 Albany Building
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25 Cords a Day

Easily Sawed By One Man. Easy to move from cut to cut. Make big profits cutting wood. Cheap and easy to operate.

OTTAWA LOG SAW

Does 10 men's work at one-tenth the cost. Makes work easy. Engine can also be used for running pumps and other machinery. Saw blade easily removed. Write for our low price. 10-Year Guarantee.

Ottawa Mfg. Co.
1809 Wood St.
Ottawa, Kansas.

30-Day Trial.

Put Disc Wheels on Your Ford

Build them yourself, it's very easy with the Kuempel Disc wheel patterns and instructions. Life sized paper patterns, with instructions sent postpaid for 50 cents. Dept. J K

Ford equipped with Kuempel Discs

KUEMPEL CO.
GUTTENBERG, IOWA

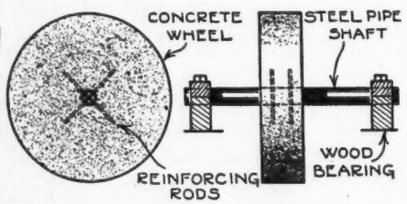
ELECTRICITY MADE SIMPLE

A book devoid of technicalities. Simple, plain and understandable. $1.00 Postpaid.
Popular Science Monthly, 225 W. 39th St., New York

How to Make a Cheap, Heavy Flywheel

ONE of the most troublesome items in the building of an amateur lathe, or any other foot-power machine, is the flywheel. A good heavy wheel is needed; a light wheel often spoils an otherwise good job, while a heavy one gives a steady, powerful motion that is conducive to good work. A cast-iron flywheel is very expensive, but practically as good a wheel can be made of concrete. When finished it looks for all the world like a grindstone.

All that is necessary is to pour concrete into a mold of the proper size and



Making this cheap, cement flywheel saves buying the manufactured article

shape and let it set hard. The mold can be made in a variety of ways, depending upon the size of the wheel. A round cheese-box answers for one size very well. Care must be taken, however, to be sure that it is round, for it is likely to be somewhat out of true. Mount it on a board base, or on the floor, and nail down blocks to press against the bulges and push them in; the low places will them come out of themselves. It is worth while to do this very carefully.

It is best to cast the wheel directly on its shaft, if this is practicable. Take the greatest pains to get the shaft exactly in the center, and exactly perpendicular to the bottom of the molds, otherwise the wheel will wobble and be a regular nuisance. Steel pipe, sold by pipe-fitters, is as good as anything for a shaft that does not run in machined bearings. Drill a number of holes in the pipe, where it will be covered by the concrete, and drive pieces of iron or steel rod into the holes, letting them project four or five inches, or even more, on each side. Have them sticking out in all directions, porcupine-fashion. This makes the wheel and shaft absolutely solid and secure. For a wheel of moderate size, say up to 18 or 20 inches in diameter, it is sufficient to use two rods, giving four projecting ends. For a wheel of this size use wire about 3/16-in. in diameter; don't make the holes so large or so numerous as to weaken the shaft.

In mixing your concrete use about one part of Portland cement to four or five parts of clean sand, and make it about as thick as the mortar the bricklayers use—or perhaps just a little thinner so that it will run and settle well into place.

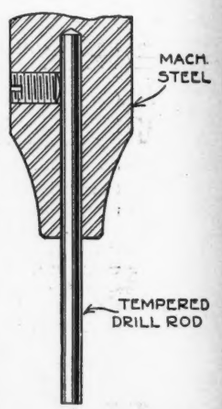
Exceedingly satisfactory bearings can be made for a steel pipe shaft of hard wood. Make the bearings in halves, split at the center line of the shaft, and fit them carefully so that when they are screwed or bolted to their beds they will hold the shaft closely without binding. Use no oil. Use dry graphite for lubricant.

A good way to get a fit and a good surface is to make the bearings so that they will grip the shaft tightly. Put in lots of dry graphite, screw the bearings down tight and turn the shaft. The wood will be somewhat compressed, and the high spots will be smoothed down. The longer the wearing process is continued the better. Then loosen up the bolts or screws, and put thin cardboard washers between the bearing halves until the fit is just right.

This way of making flywheel, shaft and bearings was tried in the construction of a good-sized amateur foot lathe. The wood bearings are so easy-running that the wheel will rock in them just as a bicycle wheel rocks on its ball bearings, and after nearly two years' use there is not enough wear in evidence to permit the thin card liners to be taken out. The bearing surfaces are black, hard and as smooth as glass.—HOWARD GREENE.

A Small Punch Fitted with Renewable Ends

ON small assembly work, such as typewriters, computing machines, small arms, etc., there is much work that calls for punches of a rather delicate nature. The one shown in the illustration is a fair sample. It is required to reach through a 7/64-in. hole, 11/16 in. in length. To forge such punches is a slow and expensive job. To turn them out of stock is quicker but the punches are not so good. Either way the upkeep cost is high.



Renewable ends in this punch, when broken, are very easily replaced

One factory has entirely discarded the solid punch for the kind shown, which speaks for itself. The bodies are made from a low carbon steel, about forty per cent, drilled and set-screwed for the renewable ends, which are cut off by the hundred from standard drill rod.

The ends can easily be given the exact temper best suited for the work and they are less apt to break than solid punches and if they do they are replaced in an instant. Their production cost is a trifle.—D. A. HAMPSON.

Announcement

For over a decade Ford owners have wanted closed-car luxury without the large first cost that goes with it.

They have wanted a Ford Top that could instantly be converted into a closed or open car without the disagreeable work of fastening and unfastening curtains.

For the first time a practical, convenient method of assuring closed-car luxury with either a Ford Touring Car or Roadster has been developed.

The USTUS Limousette is tailored to fit the Ford Car perfectly and due to its unique design there are absolutely no alterations to be made in the body or top of your car.

A roller window at each door, of sturdy and permanent construction, rolls up out of sight in the top at a light touch.

This enables the car to be instantly converted from a cozy closed car in winter to an open car for the breezes of summer. Also it enables you to keep out the dust and rain.

Clear vision, both front and sides, is another convenience.

The Ustus Limousette weighs only 40 pounds and can be installed in an hour. The price is $46.00 for Touring Car and $30.00 for Roadster.

Ask the Ustus Dealer in your town to demonstrate its advantages. If there is not a Ustus Dealer in your locality write us directly.

DAFOE-EUSTICE CO., *Manufacturers*
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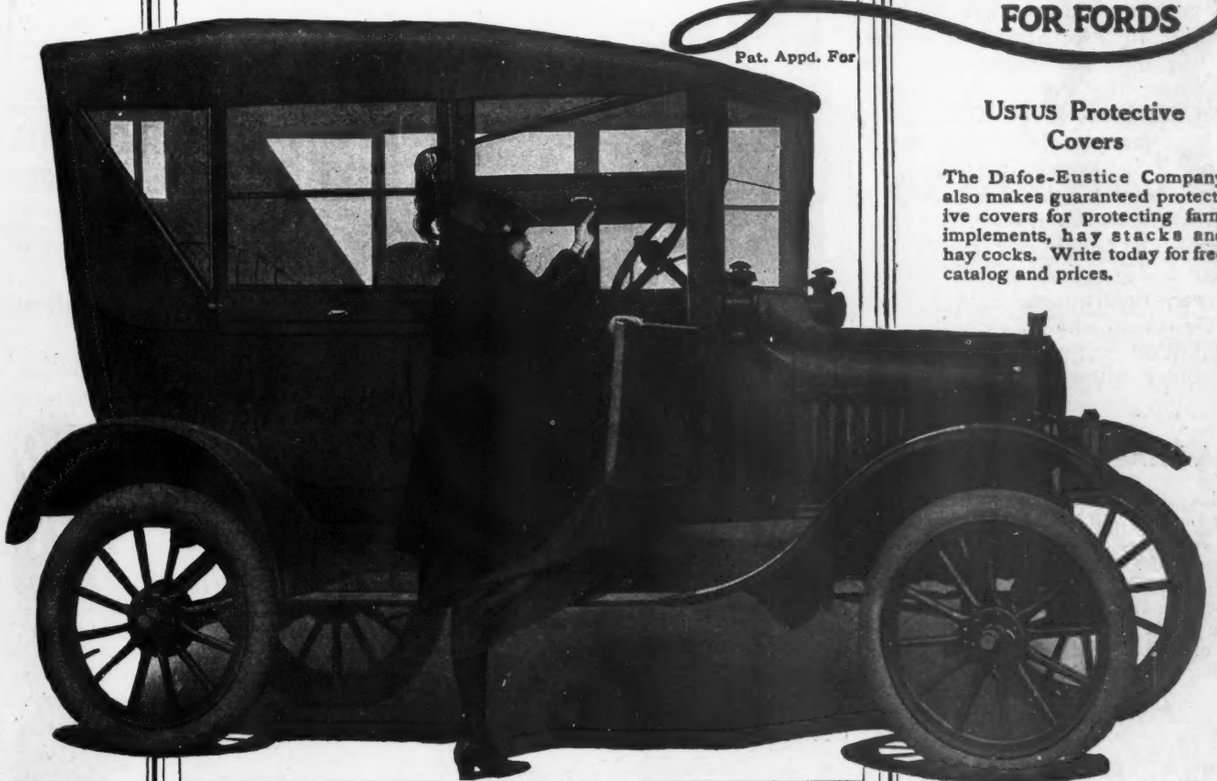

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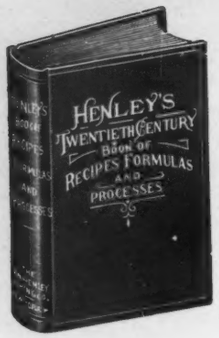

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Pipe Brackets to Support Bottom Boards of Wagon

ORDINARILY, in dumping the load from a wagon, the bottom boards must be lifted over the high sides and placed on the axles. This is inconvenient and can be obviated if two brackets, as illustrated, are made for supporting the boards. For each bracket use three pieces of pipe, about 1 in. in diameter, screwed into two, 90-deg. elbows. In this way a convenient ledge is formed on which to place the boards.—E. W. BUERSTATTE.

Wagon sides fitted in the fashion shown will permit doubling the load

Keeping the Pores of Your Skin Free from Grime

MACHINISTS and mechanics know how difficult it is to remove thoroughly from the skin, the grime that is the inevitable consequence of the oil and metal dust that pervades every machine shop. The following suggestion will be found useful for the removal of grime, paint, and kindred substances from the skin.

Before starting to work take a good soap that will lather well (many of the good grade laundry soaps are better for the purpose than the fine toilet soaps, and plain castile or white borax soap can't be beaten) and wash the hands and arms with enough soap to make a good heavy white lather, the more the better. When covered with the lather, don't rinse or wipe, but keep rubbing until the lather has dried in.

The dried lather coating prevents the grime from getting into the pores

When your work is finished, take only a little water at first, just enough to wet the skin, and rub briskly, and the lather will rise again.

The pores of the skin being filled with the soap will keep the grime upon the surface. The lather forms under the grime and forces it out. When the lather is well risen, rinse and wash as usual, and you will be surprised how easily the most refractory grime comes off, and how pure and clean is the condition of the skin. Of course, strong lye soaps should be avoided.—C. A. PEASE.

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Greatest Labor and Money saver ever brought out to enhance **Automobile Efficiency** guaranteeing more mileage, a saving of gas and the elimination of ninety per cent motor troubles—Lasts a life time—Easy to use—Saves its cost every time you grind your valves.

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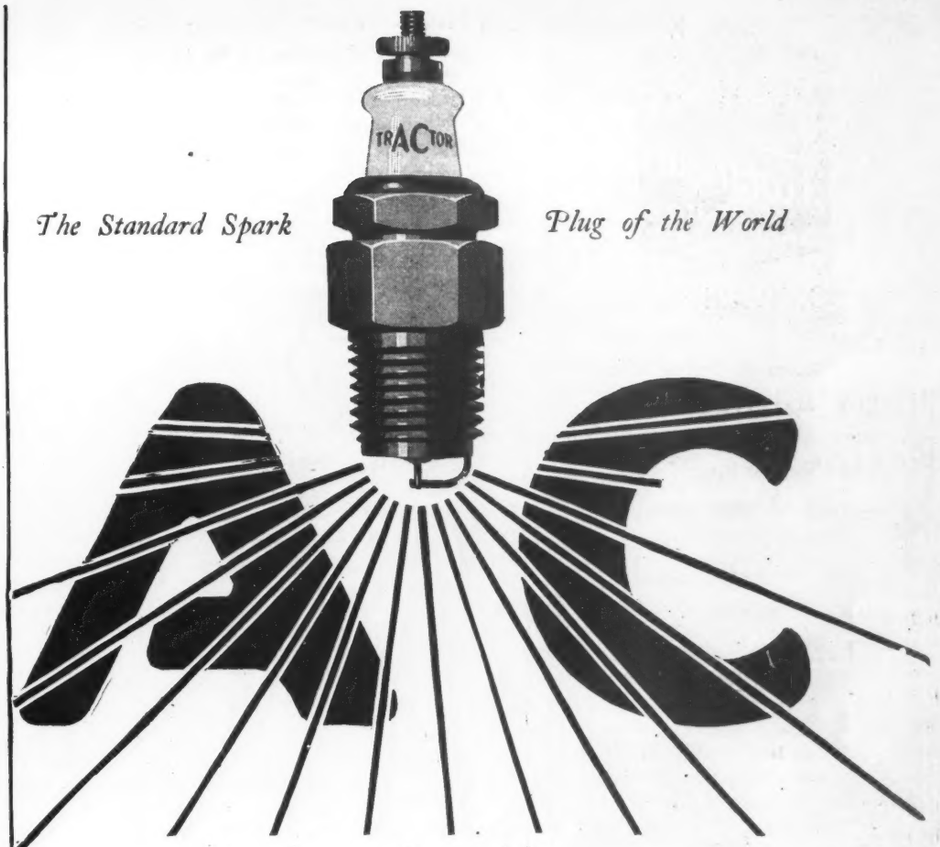
The Standard Spark Plug of the World



It Solves the Three Big Tractor Problems

The new, two-piece AC Tractor Plug is ready. It incorporates two exclusive AC features which recommend it for general tractor use and particularly for engines that burn kerosene.

Tractor users everywhere will appreciate the advantages of these features which overcome the three common disadvantages.

1—Because tractors are frequently left exposed to the weather or because kerosene is used in the engines, spark plugs tend to foul quickly.

The AC Tractor Plug will not foul readily because it has the famous AC Carbon Proof Porcelain with the knife edges that attain terrific heat which burns off carbon as it is formed.

2—After the average plug is taken apart for cleaning there is danger lest a gas-tight joint may not be secured in reassembling. A leaky joint means a quickly ruined porcelain.

The AC Tractor Plug with its welded porcelain assembly is always gas-tight. Furthermore the bushing is ground concentric with the lower shell so that the middle electrode always comes exactly in the center of the shell.

3—In the two-piece type of tractor plug where tightening strain is directed to the porcelain itself, cracking or breakage may result.

The "AC Tractor" design puts all tightening stress on metal parts where it belongs. No strain whatever is transmitted to the porcelain.

This AC Tractor Plug is no experiment. It has been thoroughly tested and proved in every type of gasoline and kerosene burning engine.

Your dealer can supply you with these plugs now. Equip your tractor with them and see how they put an end to your spark plug troubles.

Champion Ignition Company, FLINT, *Michigan*

U.S. Pat. No. 1,135,727, April 13, 1915, U. S. Pat. No. 1,216,139, Feb. 13, 1917, Other Patents Pending

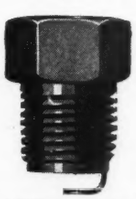
TRACTOR TYPE

"AC Tractor" Porcelain-Bushing Assembly.

The porcelain is welded right in the bushing, insuring a gas-tight union at all times. Note the sharp edges of the porcelain. These knife edges attain great heat which burns off carbon as fast as it forms. This is the famous AC Carbon Proof construction

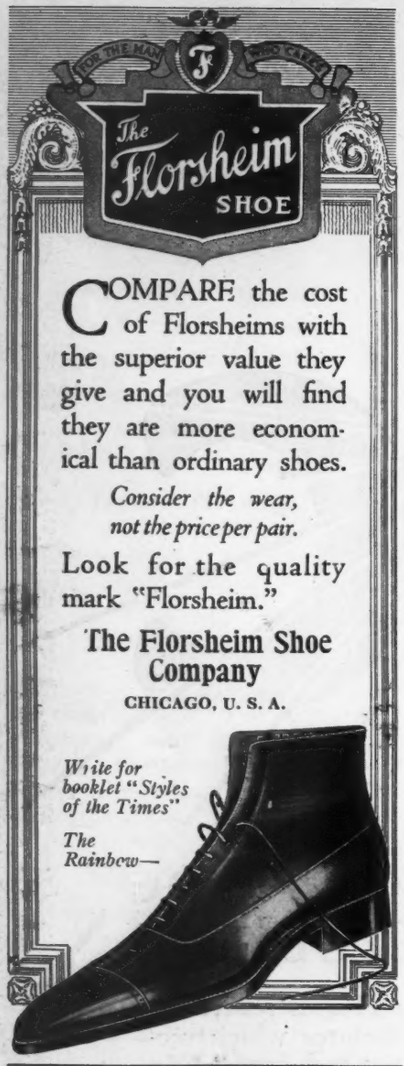
Copper-asbestos Gasket

This is seated in the shell at the base of the bushing, is an added precaution against gas leakage.



"AC Tractor" Shell

This shell and the porcelain are ground concentric. Therefore the middle electrode always comes directly in the center when the plug is assembled. The porcelain-bushing assembly is screwed into this shell. No matter how tightly the fit is made, the strain always comes on the metal, never on the porcelain.



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A High-Grade Varnish from an Old Automobile Tire

THE old tire is first cut up into very small pieces with a pair of shears. This is accomplished very easily if both the tire and the shears are kept wet. The rubber scraps, which weigh about ten pounds, are

Another use for old tires. They make a fine varnish for hardwood floors

then put in an iron pot (an old wash boiler will do) and covered with water, to which two pounds of caustic soda is added.

The pot is put over a fire and thoroughly boiled for two or three hours, after which the rubber scraps, now devulcanized, are washed and spread out to dry.

Ten one-gallon preserve jars are next obtained and into each is put about one pound of the dry rubber scrap. The jars are then filled with benzole (not benzine) and left for about ten days, or until the pure rubber is dissolved in the benzole, leaving a sediment of zinc oxide and other fillers, which are used in the manufacture of automobile tires. If the jars are shaken occasionally the rubber goes into solution much quicker.

The rubber solution, which is about six per cent rubber, is decanted into clean jars and is ready to use in making the finest flexible and waterproof varnish at a cost of less than thirty cents per gallon.

The following formula gives the proportion for one gallon:

Dissolve two pounds rosin in a quart of benzole; then add four ounces benzine and one-half gallon rubber solution.

A varnish with a much harder surface can be made by using manganese resinate, or, in fact, any metal resinate in place of the rosin.

It is well known that rosin varnishes have a luster far superior to any other gum varnishes, with the exception of sandarac, but the rosin always cracks. The mixture of rubber and rosin will always be flexible and still retain its luster.

The small quantity of benzine is added to make the varnish flow freely; without it the varnish gets stringy under the brush.

Following are some of the successful uses found for the varnish made as described above:

Varnishing hardwood floors; as a metal-protecting coating for brass beds, and bright metal work on automobiles; as a bronzing liquid—it does not attack either aluminum or bronze powders, so makes an excellent vehicle for them; used in place of shellac on armatures and insulation work; as an automobile body and shed paint—dissolve one-fourth pound of oil black aniline in a gallon of the varnish; as a waterproof roof paint—mix four pounds dry red lead with a gallon of varnish, give the roof one coat of this paint and a second coat of the plain rubber solution; as a house paint—mix four pounds of any color pigment with a gallon of the varnish.—JOHN E. CLEGG.

To Remove Nails Without Damaging Fine Wood

VANDALS are, unfortunately, like the poor—they are always with us. Antique furniture is by no means

The top of the nail is drilled off, then wax is inserted in the hole to camouflage it

exempt from their depredations. Consequently, at times one finds fine old Sheraton, or Chippendale, or other pieces, with nails or tacks ruthlessly hammered into their legs, panels, etc. Truly a sight to make angels weep.

Here is a way to get rid of such nails:

First, consider well the nail. Note its size, as judged from the head. If a bit of the shank shows, it will be easy. The length of the nail does not matter; what you want is the size and diameter of the shank. Having ascertained that, select a metal drill that will be a size over the diameter of the nail's shank. With a center punch, make a seat for the drill exactly in the center of the nail's head. Drill carefully into the head of the nail, until you cut through the head into the shank, and the head will come off in the form of a small button. A drop of hot wax will close up the tiny hole and will pass for a small wood knot when the article is refinished.

Does Present Day Gasoline Give Your Car Indigestion?

THE superior gasoline of a few years back and the gasoline we must use today, are two very different products. The "gas" of today is too heavy. It will only partially vaporize. But the engines are still built to consume the fuel of a few years ago.

The low-grade fuel-blend of today must be reckoned with. Undigested food clogs your system. Can you swallow your food in lumps? Neither can your car.

Why does the gasoline in your car today give your engine indigestion? Because the fluid is partly pure gasoline and the rest a kerosene-like liquid that forms into drops, instead of vapor-fog. These drops soon make their way into the cylinders and the crankcase, cutting the lubricant and causing friction. The poorer the gasoline has become, the steeper have been the repair bills. As the gasoline becomes more and more like kerosene with each year, your repair bills increase.

It is impossible to change the fuel—to go back to the gasoline that automobile engines were designed to burn. There is not enough of that kind of gasoline to go around. Hence, the engine must be changed.

The Chalmers engineers have worked over this problem for two years, making exhaustive tests and experiments. The power was in the gasoline, but the old style engine could not get the power out.

The Chalmers HOT-SPOT manifold with the Ram's-Horn shape has wonderfully solved the problem. There's no waiting for the engine to warm-up in the new HOT-SPOT Chalmers. She starts easily and promptly even on the coldest mornings. Why?—As soon as a drop of fuel strikes the Hot-Spot, it is vaporized at once. It can't work down into the crankcase and do irreparable damage; it is used to drive the car.

Then the Chalmers engineers designed the famous Ram's-Horn shape of manifold. The Ram's-Horn, because it is free from carbon, makes it easy for the vapor to enter all cylinders uniformly. Ordinarily the sixth cylinder gets either very little gasoline or just the raw, unvaporized drops. The Ram's-Horn manifold supplies an equal amount of mixture to all six cylinders, gives you all the power from all the cylinders. The vapor is fed uniformly. Reduced vibration, lower upkeep cost, more power and more mileage are realized.

The most wonderful automobile engine in the world today is under the hood of the Chalmers automobile.

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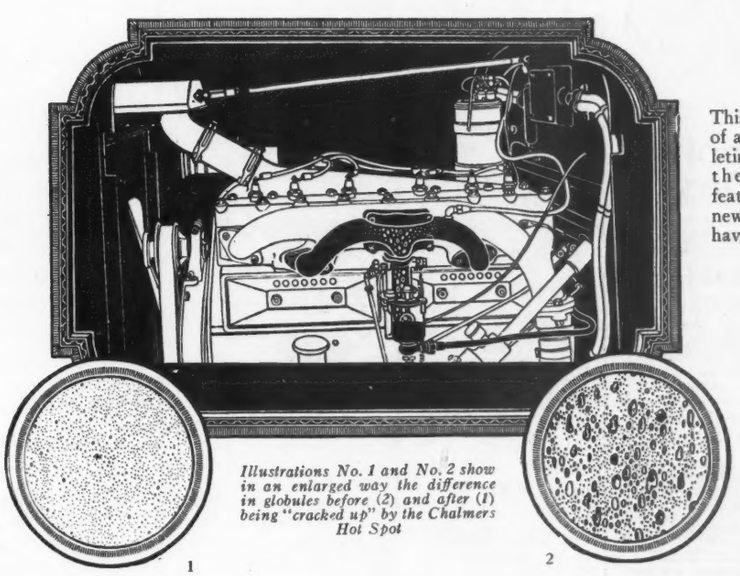

Illustrations No. 1 and No. 2 show in an enlarged way the difference in globules before (2) and after (1) being "cracked up" by the Chalmers Hot Spot

1 2

This is the sixth of a series of bulletins in which the wonderful features of the new Chalmers have been explained.

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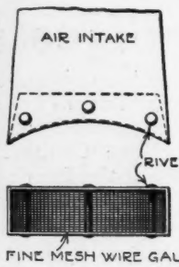
Preventing Road Dust from Entering Carbureters

ON one of the older models of a well known make of motorcycle some trouble was experienced from road dust and grit being sucked into the air intake of the carburetor. To overcome this annoyance the air intake was fitted with a piece of extremely fine mesh copper gauze. The opening was rectangular in shape, and the edges of the casting, which was of aluminum, were slightly concave to allow it to fit closely to the heat radiating flanges of the cylinder. The gauze or screening was cut to fit the opening neatly, and the top and lower edges were turned over and slipped into place. Then three holes for nails were drilled through both of the flat sides of the casting and the turned over edges of the screening. Three finishing nails were used as rivets to hold the gauze in place, by slipping them through the holes from the top and riveting over their ends on the bottom side.



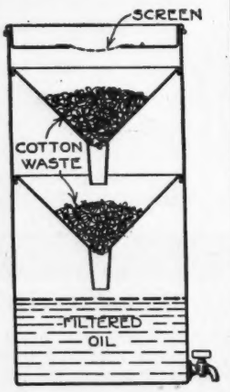
If you own a motorcycle here is a way to prevent the carbureter from clogging

The reason this method was used to fasten the gauze was because of the fact that it could not be soldered to the castings as they were made of aluminum.—JOHN A. WEAVER.

Save and Filter the Old Oil from Your Car

THE writer, in common with other automobilists, has found that the oil bill for his car is a considerable item. Deciding to cut down this expense he constructed a filter, for about fifty cents, as shown in the illustration, and before long saved much on the cost of new oil.

First, he placed a small screen at the top of a four-gallon can, letting the dirty oil run through it into a funnel containing clean waste. From the first funnel it ran into a second, and from there into the bottom of the can, whence it was drawn off with a cock.



Save the old oil and filter it by this method

This proved a very satisfactory filter, and one that the readers of the POPULAR SCIENCE MONTHLY would do well to copy.—J. W. MOORE.

Hundreds of

IDEAS

For the Owner, Manufacturer, Dealer, Mechanic in

The 1920 Motor Annual

of the

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The biggest book of its kind ever published—invaluable to everyone interested in Motor Vehicles and Accessories. It will accurately picture and describe more than 400 new devices and accessories and give scores of practical ideas to the Owner, Manufacturer, Dealer and Mechanic.

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Matching the wonderful development of the automobile industry—(there are six and a half million Motor Cars and Trucks registered in the United States) is the growth of the Motor Annual. The 1920 edition is limited to 100,000 copies. Order now if you wish to make sure of getting a copy.

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Motorcycle or car? If it is a car, which lamp is out—left or right? Lamp-unreliability is both *dangerous* and unnecessary. The known high standards of MAZDA Service are sufficient to make cautious and considerate motorists insist on having MAZDA Lamps—*lamps marked MAZDA.*

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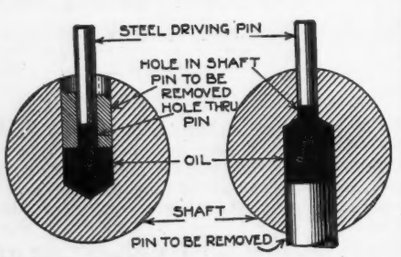
A folded blanket is placed over the horse to form a cushioned seat, and a circular strap holds it in place. Two side straps are riveted to the main

For the amateur learning to ride, a saddle of this sort is a great help

strap to hold the stirrups. The saddle is now ready for use. The straps are supplied with buckles so that they can be adjusted to individual needs. This saddle is very serviceable and may be used as a means of bettering one's horsemanship.—G. H. GLITZKE.

Method of Removing Broken Pins from a Shaft

FREQUENTLY, when a pin becomes rusted or broken off in machinery shafting, the operator, without thought, injures the threads of the hole when removing it. Great pressure upon the broken pin may sometimes remove it, but if a small hole is drilled through the broken pin and oil poured into the hole, filling it to half its length, and then pressure is applied, the pin will usually come out without further trouble.—WILLIAM FARRAY.



Broken pins in shafts cause a lot of trouble. Here's a way to remove them with ease

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A Frame to Hold the Fruit-Straining Cloth

TO prevent the possibility of the straining cloth from slipping over the mouth of a kettle, jar, or pan, the little device here illustrated will prove a boon in canning time. The two vertical pieces may be fashioned from 3/8-in. thick boards and the cross slats from 3-16-in. thick pieces.

The experienced woodworker will

No more spilling of fruit juices if you have this strainer frame in your kitchen

probably prefer to mortise the ends of the cross slats into the vertical arms, but they can be nailed or screwed in place just as well. The four nails or brads will hold the cheesecloth or other strainer material securely in place.—CHARLES TAYLOR.

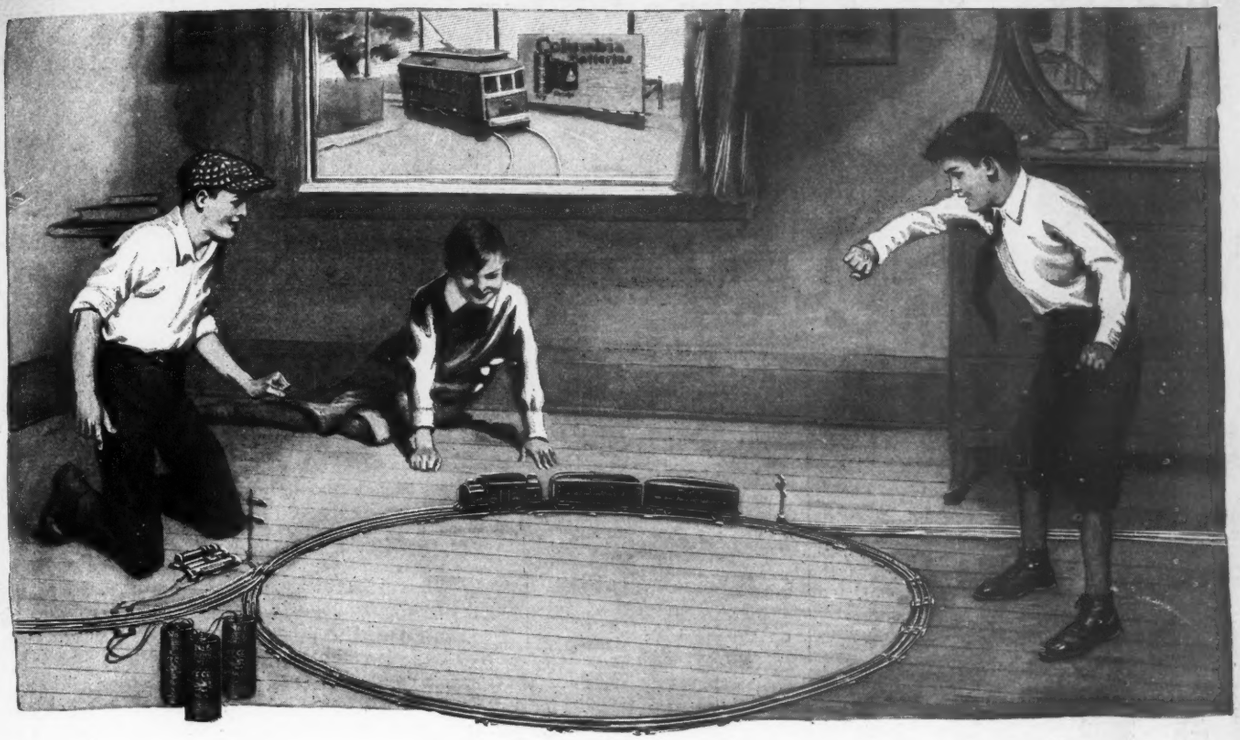
Make a Hole in the Storm Curtain

DRIVING through rain, snow or fog is dangerous business at night if the storm curtains entirely enclose the car. The searchlight at the left

A means of operating the searchlight is necessary when the windshield is filmed

of the driver cannot be used unless the curtain is unbuttoned.

A circular hole, large enough for the arm to be thrust through, can easily be cut in the curtain and patched in the manner shown in the illustration. This will prevent the rain from entering the car but allow the driver to get at the searchlight.—C. C. SPREEN.



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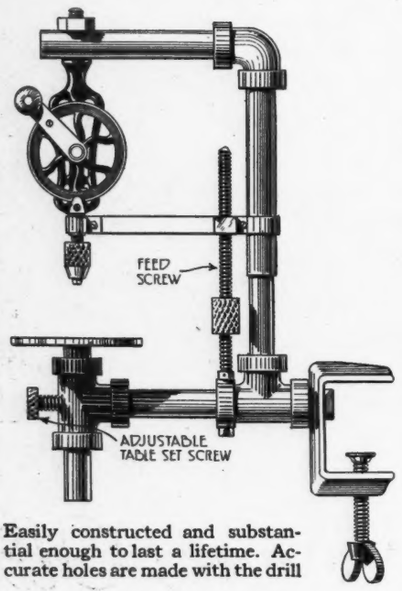
Making a Drill-Press from Old Pipe and Fittings

WITH a few pieces of gas-pipe and fittings a very useful drill-press can be made.

Take a piece of gas-pipe, 10 in. long, with one end of it threaded and a 90-degree L fitted to it. To this couple another piece of pipe 5 in. long. About half an inch from the end of this, drill a hole the size of the screw on your hand drill, from which the handle has been removed, and find a nut to fasten it on the top. Now take a piece of strap-iron ⅛ in. thick and bend this around the longer piece of pipe. Make it tight with a bolt or rivet, so that you can bend the other end of it around the drill, as seen in the drawing. Be sure that the drill is now in a vertical position.



Easily constructed and substantial enough to last a lifetime. Accurate holes are made with the drill

Now take a piece of gas-pipe about eight inches long and of such diameter that it will slide into the 10-in. pipe. Grind out and polish the two pipes and you will get a very good fit.

Connect this smaller diameter pipe with the outlet of a T-joint. Now attach a second T-joint to the first with a piece of pipe of sufficient length so that the opposite openings correspond with the center of the drill. Through this second T-joint run a piece of round iron or pipe, onto which fasten an iron plate (a cover from a kitchen stove will do), for the table to rest your work on. Put a thumbscrew in the middle of the T for fastening the table at the desired position.

For the feeding mechanism procure an iron bolt about 8 in. long and ¼ in. thick, with half of its length threaded. Now drill a hole the size of the bolt perpendicularly in the short piece of piping, between the two couplings, and about an inch from the first one, and insert the bolt into the hole. Above, close to the piping, fasten a collar, as seen in the drawing. Place a knurled adjusting screw at the middle of the unthreaded part of the bolt. Now run the nut on the bolt up to the connecting arm and fasten it to or between the strap-iron bracket. By turning the adjusting screw the upper part of your drill-press can be raised or lowered. For fastening the drill-press to a table or a bench, attach a common clamp to the remaining open coupling.—STEVEN NAGY.

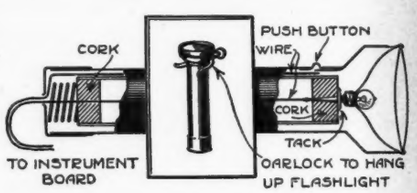
The Pocket Flashlight May Become a Spot-Light

THERE are times when the automobile breaks down out on the road and failing a "handy repair light," it is useful to know how to connect a pocket flashlight with the storage battery in order to provide illumination to repair the break-down.

This may be done by removing the flashlight's dry battery and plugging up the lamp end of the cell container with a wooden plug or cork. Drive an upholstery nail or ordinary tack into the center of the cork to make the contact with the lamp and connect one wire to it. The other wire is grounded upon the metal container and both are threaded through a hole in the cap on the bottom end.

Care should be taken to see that the lamp in the flashlight is of the proper voltage. The 6.2 volt lamp with the miniature base should be used where the car lamps are labeled 6-8 volts, and where the voltage is the higher the lamp should be bought to correspond.

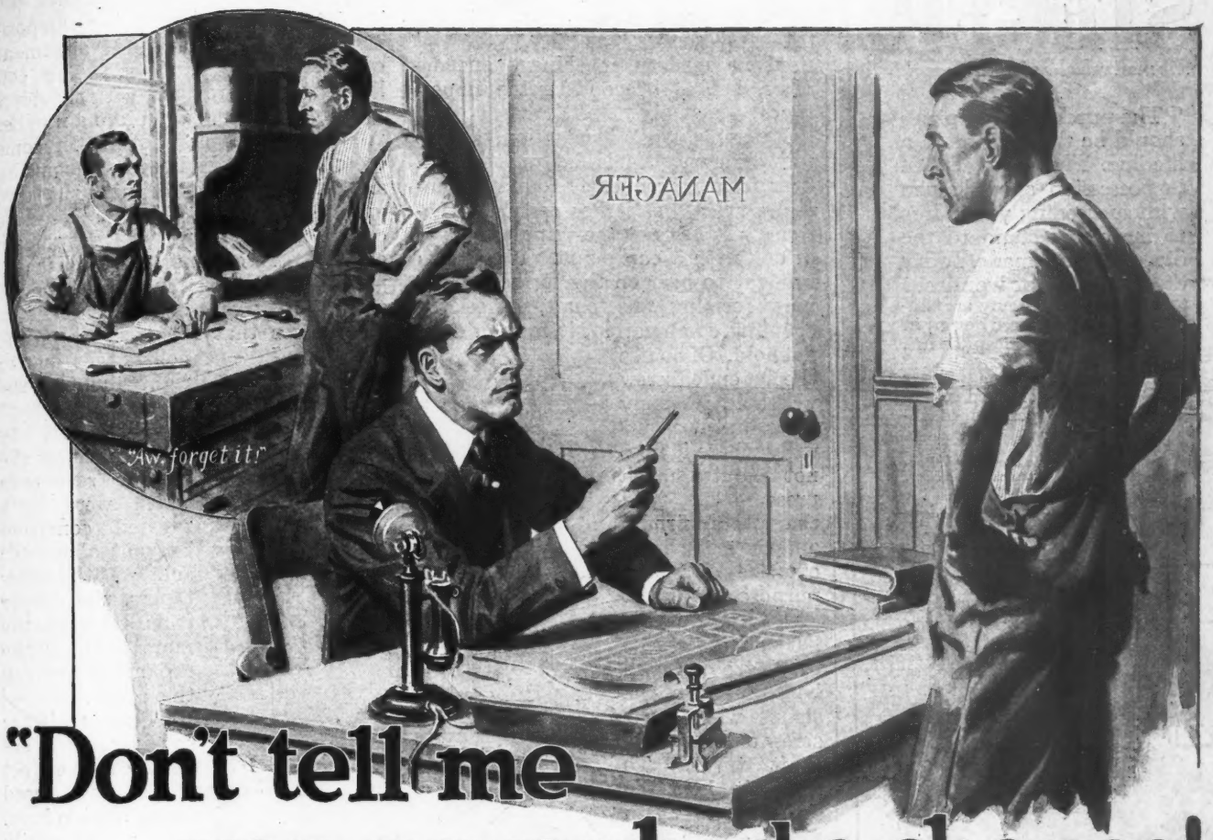
The flashlight with the large reflector or the so-called "miner's trouble lamp," two- or three-cell type, costs from $1.50 to $2.00, and it can be made into a practical trouble lamp and spot-light for the automobile. It is better than the ordinary automobile spot-light, for when the top curtains are attached, this type of lamp is worse than useless.



Transforming the pocket light into an automobile spot-light is not so difficult

Make a dummy battery of a piece of broom handle of the proper size and drill a small hole through it, capping it with a piece of brass. The lower half of a nickeled shaving stick box is just the size for the other end of the dummy battery and the other wire is soldered to it, both of course, being threaded through the hole previously bored in the cap of the flashlight.

The light may be turned on and off with the push button in the handle, and, providing sufficient flexible cord is provided, it can be used in any part of the car.—C. B. EDWARDS.



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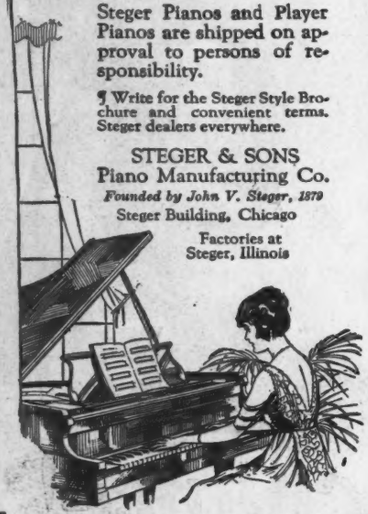

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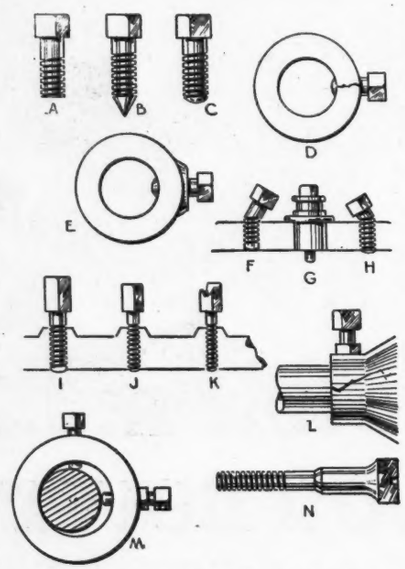
Set-Screws—Their Uses and Abuses

By Charles R. Fisher

THE problem of set-screws, as used in modern machinery and devices, is one of considerable importance.

Referring to the illustration, the set-screw shown at *A* is flat on the end. This form is frequently found in general service, but it has certain objections. It has not the gripping power of one with a cup point. When it is brought to bear on the surface of the part forming the shaft, wheel, or coupling combination, it may or may not hold. Of course the flat ended screw will hold in many cases, but it is usually where it does not require much pressure to hold the parts firmly, and the screw is an oversize for that purpose. In most cases where the flat ended screw is used grooves will be formed in the shaft where the screw cuts in as the shaft turns. To make it hold the set-screw is again tightened in the groove and a part of a turn is given from time to time. It is obvious that the shaft will soon be ruined by this method.



Set-screws are of different shapes, and you should know how to insert and adjust each kind properly

Next let us observe the extremely pointed set-screw *B*. The point is hardened, and usually ground quite sharp, so that a hole is made in the shaft where it is set. The point is intended to give a good grip. This type of set-screw must be reset every time the part it holds is adjusted. If the collar is to be turned on the shaft for any reason the point will tend to enter the old hole if not turned entirely out of its original position.

Owing to the shortcomings of the other two types, the set-screw with the rounded end is usually employed. The oval ended type *C* can be tightened on to the shaft with considerable force without actually denting the latter.

Some builders of machinery make an excellent design of screw which is about midway between the round and the pointed end.

Don't Crack the Collars

In making even a casual examination of machinery and shafting in mills, shops, and other plants, one finds set-screws in service under varying conditions. The condition found prevailing in a number of collars used in an electrical power plant is shown at *D*. These collars were used on either side of the shaft journals for the purpose of retaining the position and alignment of the driving pulleys. The collars were not provided with shoulders for strengthening, therefore a number were fractured as shown. In some cases the defect had been overcome by shrinking a band of wrought iron around the collars. In other cases the collars were permitted to remain cracked. In one instance a collar was provided with a strengthening shoulder, as shown at *E*. It was found in some cases that the fracture in the collars was due to tightening up the set-screw too hard on the shaft. In other instances the use of set-screws which were in a tapered condition brought about the split. If the screw tapers, the deeper it is inserted the more liable is the expansion to crack the collar.

There is always considerable annoyance when set screws are used which are too long. An unnecessarily long set screw is liable to catch the clothing of the workers and do damage. A long set-screw is likely, also, to become bent as shown at *F* in the illustration.

In a certain flour mill there were found long set-screws in collars as shown at *G*. This system is a poor one. In some cases, instead of washers, some unusual parts were employed to fill in the space. Sometimes the threaded part of the screw was worn out and a hole was drilled in a bushing substitute. The bushing was drilled and tapped for the set-screw and then brazed into the hole in the collar or wheel.

Use the Right Sized Screws

Fractured portions of set-screws, with the defective part at the edge of the hole, as shown at *H*, are not uncommon. Quite a number of instances were found where the set-screws had come in violent contact with some object and were bent over and partly broken off. When a set-screw gets in this condition the only remedy is to substitute a new one of a shorter length.

At *I*, *J*, and *K*, three set-screws are illustrated showing comparison of sizes. If one were to look through some of the shops he would soon locate set-screws in use that were a great deal larger than was necessary. The oversize set-screw *I* is liable to bulge the part into

which it has been inserted and fracture the metal. Often a set-screw will be found in use which is too small, one of which is shown at *J*. In this case the set-screws have not body enough to grip firmly. The screw with a broken or worn head is shown at *K*. Such set-screws may be found in our best shops. The monkey-wrench in the hands of a new man often causes defects of this nature.

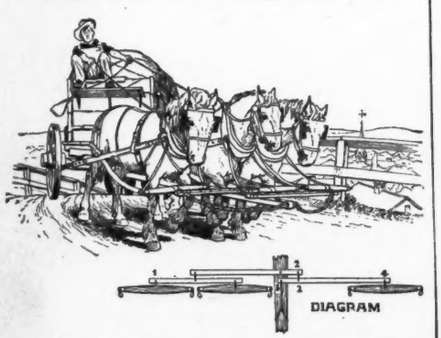
Many times the hubs of gears and wheels are cracked because of unnecessary pressure on the set-screws. This is shown in the illustration *L*. The set-screw is fitted in the shouldered portion of the hub. Perhaps the set-screw point is placed in a depression in the shaft. The result is that the set-screw is forced outward, often to the point of cracking the hub.

It is not unusual to find samples of crude work with set-screws as seen at *M*. The shaft is too small for the hole in the collar or hub, and the workman tries to overcome the difficulty by adjusting the set-screws to take up the difference. The chances are that the shaft will be thrown out of line to some extent, unless there are an equal number of set-screws. In the case shown the set-screws are two in number and so set that the points force the shaft off center. Sometimes the shaft is held in the center by using strips of metal as keys on the side opposite the set-screws. This is a slipshod way of doing work. A better way is to insert a sleeve, but the only proper way is to remodel the parts and adjust them so that the collar fits snugly to the shaft.

The illustration *N* shows a set-screw that can be driven with either a screw-driver or a monkey-wrench.

A Three-Horse Equalizer on a Two-Horse Tongue

WHENEVER it is desired to use three horses on the usual two-horse tongue, the arrangement shown



Attaching three horses to a two-horse team isn't hard if you know how to do it

in the illustration will be found to be practical. Measure off the distance from the end of the equalizer to the tongue and vice versa on the other side.

There are other ways of enabling three horses to work on a two horse tongue, but this arrangement has less side draft than the majority.—CHARLES TAYLOR

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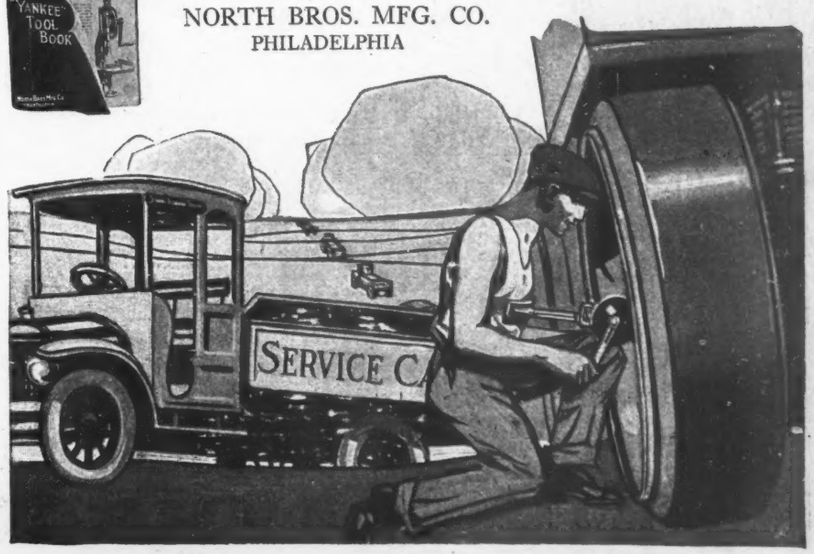

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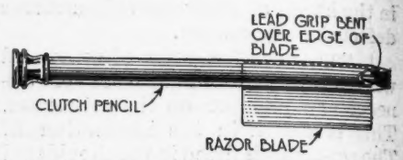
Use Old Safety Razors to Sharpen Pencils

A CONVENIENT tool to have on the desk for cutting paper or sharpening pencils is a safety razor blade. A neat and serviceable handle for it may be made from a metal refillable pencil. Cut off part of the



Another use for the old safety-razor blade is to transform it into a neat paper-cutter

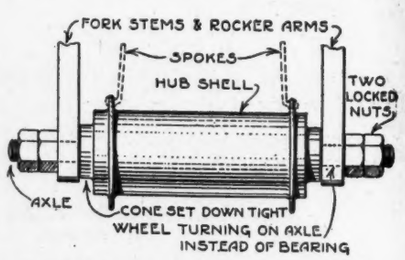
shell at the tip and slot one side to take the safety razor blade. The small clips used to hold the lead are bent over at the end to grip the end of the blade. After slipping the blade into the slot, the bent ends are caught on the edge of the blade. A few turns of the head of the pencil clamps it rigidly in place.—THOMAS W. BENSON.

An Emergency Motorcycle Hub Repair

WHILE twenty miles from home recently I had the experience of having the ball-races and bearings of the front wheel of my machine go to pieces. The wheel locked, the machine spun around in the road and stopped, and for a few minutes it looked as if I was there to stay.

I took off the wheel and removed the cones, but they were far beyond hope of repair. I had to find some way to move the machine.

The axle was a long one, the type that is used to prevent the fork rockers from turning over. After removing all the particles of bearings and ball-races, I set the cones down just as tight as I could turn them with a wrench—the axle was of the knock-out type. I then put the wheel back, but instead of its turning on the bearings and cones it turned upon the axle, and the axle turned inside the fork rockers.



Ball bearings are liable to become faulty at any time. Here is an emergency repair

I then ran a generous quantity of oil along the axle and away I went just as nicely as if nothing had happened. The parts got a little warm, but I oiled them every five miles and so made the twenty miles home without any difficulty.

Upon taking the arrangement apart nothing seemed to have worn out and I easily fitted new parts.—JOHN E. HOGG.

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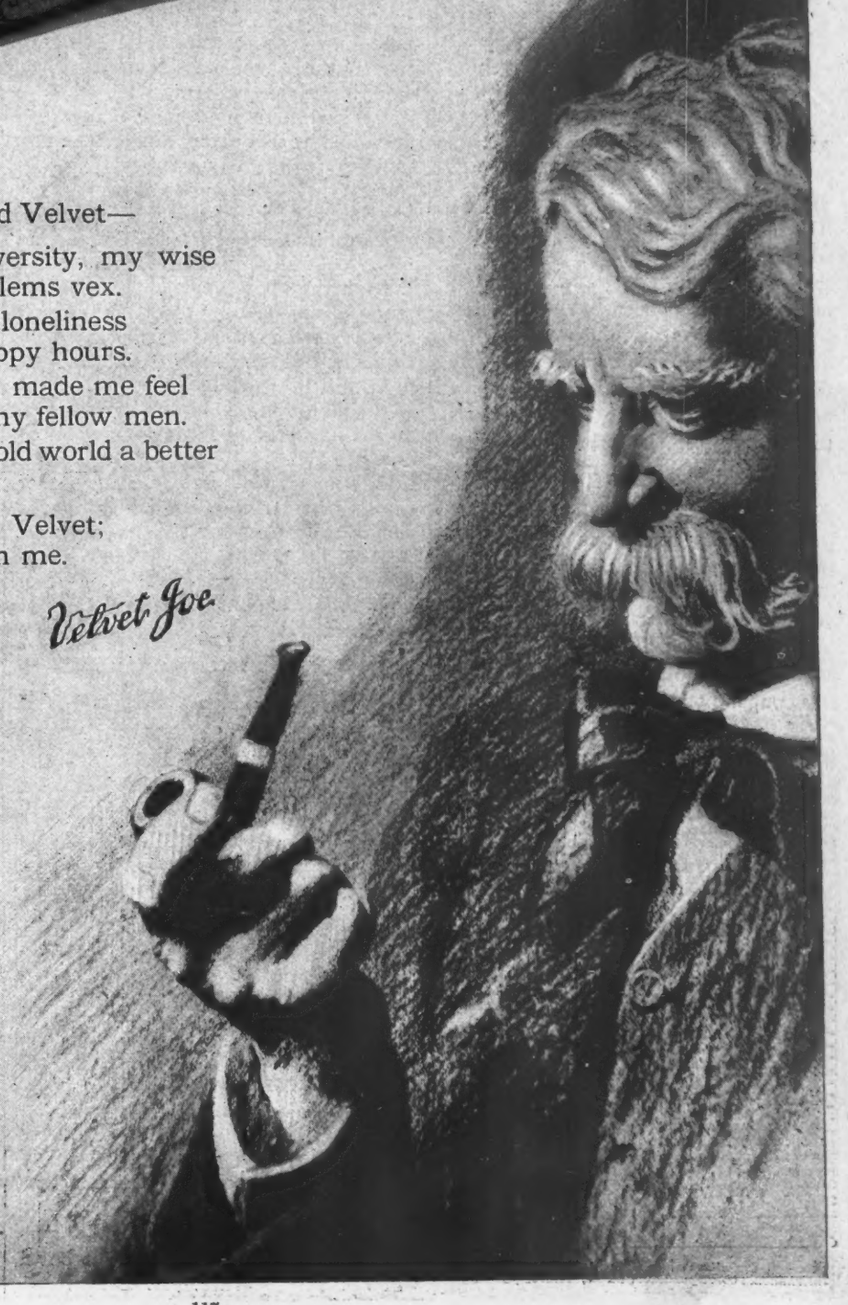
I love my pipe and good old Velvet;
no one shall take them from me.

Velvet Joe.



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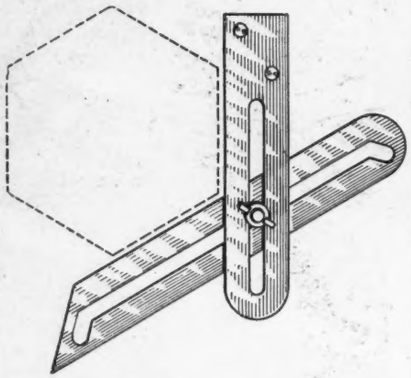
Making a Bevel Gage for Transferring Angles

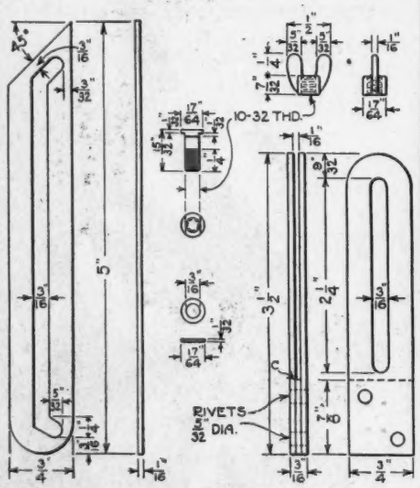
THE bevel gage is very handy for transferring angles and bevels. For instance, a slide with angular sides has to be filed and fitted to a machine



The completed gage is used for obtaining angles and depth of machinery

part that it is to work in. The gage may be set to the existing angle of the side already finished and the part to be worked upon may then be machined and filed to the exact angle, thereby making the two surfaces fit exactly together. It may also be used for obtaining the depth and angle of recesses that are within its range, and many other like measurements.

Both the blade and beam should be made of spring tempered steel, which is not hardened. If this is not obtainable ordinary soft steel may be used, but it is not as good on account of its liability to bend and dent easily. In making the blade, lay out the slot and finish it to size before starting on the outside surfaces. The separator should be riveted into place before the slot is quite finished so that no part will be out of alignment. The wing-nut may be worked out of a piece of ½-in. cold rolled steel. Both the nut and screw take a 10 by 32 thread. Be



The plans are first laid out in detail, so that later each part may be trued up

very careful to leave the parallel surfaces exactly straight or else the bevel will not be accurate.—A. DANE.

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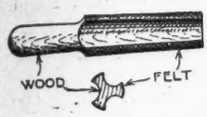

The cleaning stick assures you of an accurate hole

The machinist usually takes a piece of waste to clean the taper, but the illustration shows a little device that will do the cleaning much better.

The tool consists of a piece of wood, turned to snugly fit the taper, with a handle on the other end. The taper part is then fluted like a reamer or tap and a piece of felt glued to its contour. As this fits the taper hole closely the dirt is swept out and falls into the flutes.—CHARLES R. FISHER.

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ONCE, while developing films, I was handicapped by not having on hand any graduated glass measures. I had to measure one four-ounce quantity and one eight-ounce quantity. I happened to see in a corner of the kitchen an empty glass bottle that had contained beer (poor thing)

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and on its label was marked "contents 12 ounces." I immediately took from the cupboard three drinking glasses of equal size, filled the bottle up to the neck with water, and poured this carefully by degrees into each one of the glasses. As soon as the same amount of water was in each glass I had my task finished for the liquid was now measured out in three four-ounce quantities.—PAUL LAVENDERO.

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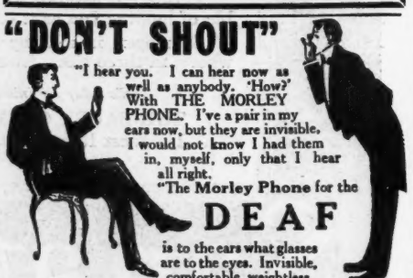

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Fitting Piston Rings Isn't an Easy Job

MANY and varied are the hints and tips which have appeared within the pages of POPULAR SCIENCE MONTHLY from time to time with reference to piston rings, yet, judging by what has not been written, I am afraid very little is known of the fundamental principles underlying their action.

But nowadays, when, owing to personal predilection or enforced economy, so many owners do their own decarbonising, it would surely be better if amateur mechanics more thoroughly understood the principle and action of piston rings.

The Behavior of Gases in the Cylinder

I will, therefore, try to throw a little light on this important subject, and would like to add, in passing, that

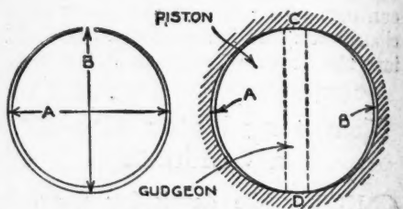

Fig. 1.—An exaggerated sectional view through a portion of a cylinder

what follows is not mere theorising or hearsay, but the result of years of personal experience in car doctoring.

Fig. 1 is an exaggerated sectional view through a portion of a cylinder, piston and ring—the clearance between the piston and cylinder wall and between the ring and groove being purposely exaggerated for the sake of clearness.

Suppose combustion to have taken place. Then the small arrows show how the products of combustion, or gases, as they are generally named, press in all directions. The piston, of course, moves down. The gases, in their efforts to find the line of least resistance, pass down between the top of the piston and the cylinder wall, and, meeting the ring (Fig. 1), force it hard down on to the bottom side of groove *B*.

Leaks Past the Rings

The outer face *A* of the ring makes good contact with the cylinder wall owing to the considerable and continual friction between the two, so nothing passes between them. But the gases have easy access to the back of the ring (as shown by the long arrow), and are only prevented from blowing right through by their own action in forcing down the ring on to the bottom of the groove, as already stated.

From this it follows that the bottom face *C* of the ring and the bottom face *B* of the groove form a joint of which

the efficiency is very important. It is usually thought that gases blowing past a piston, pass between the outer face of the ring and the cylinder wall. Such, in 99 per cent of cases, is not so. As already stated, the continual friction between the two is sufficient to make and keep a gastight joint. But there is very little friction between *C* and *B*—a small particle of soot between them, a bruise or "rag" raised in careless replacement being sufficient to cause a serious leak via the back of the ring.

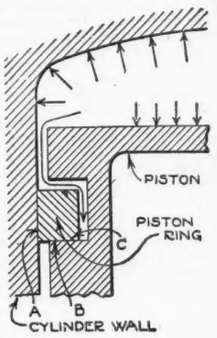

Fig. 2 The small arrows show how the gases press outwards in all directions

The existence of this "joint" may be easily verified by removing a ring from a piston of an engine that has done anything from a hundred miles upwards. The bottom side of such a ring would be found to be very much more brightly polished than the top side. Therefore, when replacing a ring, be sure that the brighter side is placed downward. It is also very important, when replacing rings, to keep each ring to its own groove.

The top sides of ring and groove form a similar joint, but on the induction stroke only. Now the pressure that is exerted on the piston, during the induction stroke is negative, and, at most, amounts only to a pound or two. Hence, the top joint does not have much work to do, and, therefore, the top side of the ring does not become so brightly polished as the bottom side.—G. F. COLLINS.

Making a Pair of Tweezers

IN first aid calls, when baby has a sliver in his finger, and in other similar home surgical cases, as well as in delicate mechanical emergencies a pair of tweezers is usually not near by and consequently you do the best you can with makeshift tools.

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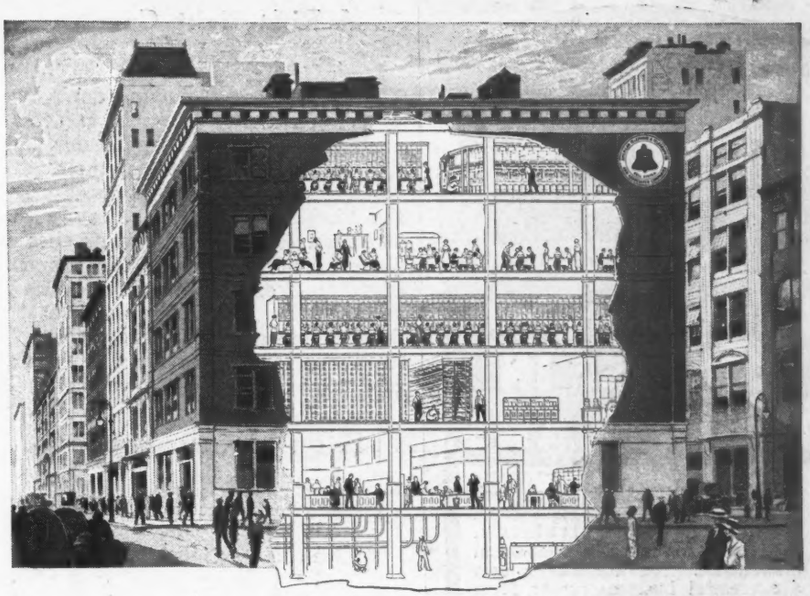
Soldering a pair of brass plates to a ruling-pen transforms it into a good tweezers

an old ruling-pen. A pair of small brass plates are soldered to the side members of the pen and the natural spring of the steel turns them into a pair of tweezers. Try out this idea and you'll never be at a loss in an emergency.—M. TOCABEN.



The Great Task of Construction

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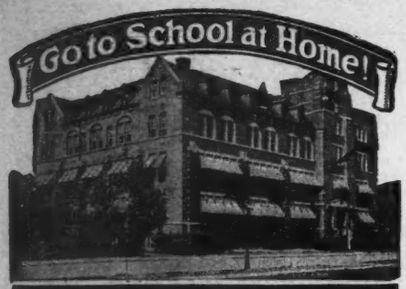

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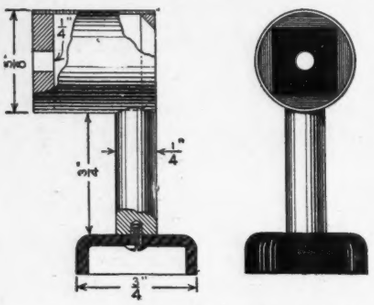
A Rifle-Sight Camera View-Finder

IN the process of cutting down the size on the very small cameras, made especially for reporters and writers, who find it to their advantage to carry a camera constantly, the view-finder is done away with. The manufacturer, however, makes a detachable finder for which he charges anywhere from two to three dollars, and the finder itself is frequently larger than the camera. The finder which I am about to describe has the double advantage of being cheap and is small



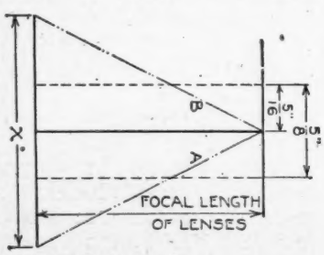
The sight-finder is attached to the top of the camera by suction

enough to slip readily into the vest pocket. It can be used on all types of cameras.

Referring to the drawing, the finder is similar to the peep-sight of a rifle. The subject is sighted through the tube.

The latter is of brass, and is 5/8 in. in diameter. To find the length, on a piece of paper, draw a line equal in length to a line drawn from one opposite corner to the other of the picture that the camera in question makes. Mark a point above the line, so placed that if a perpendicular were dropped it would cut the line into two equal parts. The distance from the point to the line should exactly correspond to the focal length of the camera. Now draw two lines, one from each end of the base-line to the point above it. Draw two lines

How the finder finds the subject and gets a focus upon it



The diagram shows the method of determining the length of the tube

parallel to the line corresponding to the focal length, 5/16 in. from it. At the apex draw a line perpendicular to the parallels. The distance between the last perpendicular and the point of intersection of the parallels with either *A* or *B* is the length of the tube.

At the end of the tube of which the upright comes, glue a piece of card in which has been cut an aperture that is proportional to the size of the picture. At the opposite end glue a plug with

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⅛-in. hole drilled through its center. Shave the inside edges of the apertures down to a thin edge.

The upright rod is ¼ by ¾ in. It is brazed or soldered to the main tube of the instruments.

To the bottom of the rod is fastened, by means of cement and a machine-screw, a shallow rubber cup.

To facilitate speed in making "shots," have the camera in one vest pocket and the finder in another. To "shoot," take the camera out with one hand, the finder with the other, lick the rubber cup, stick the finder on the camera, with the large aperture forward, and the ⅛-in. hole toward your eye. Sight your picture as with a telescope.—ARTHUR KENNEDY.

Keeping the Screwdriver from Slipping

A SCREWDRIVER that slips in the screw slot when pressure is applied is not only a disagreeable tool to work with, but is likely to mar the head of the screw and detract from the appearance of finished work.

If the end of the screwdriver is roughened by a stone it will not slip

To prevent this the first thing is to hold the driver properly, directly in line with the screw. The next is to grind the blade crosswise instead of lengthwise. The little roughness left by the stone, running across the blade, gives a sufficient bite in the screw slot to help very considerably. Filing the blade answers the same purpose.—HOWARD GREENE.

Preparing a Surface for Painting

IT is common practice, when we do an odd job of painting around the house, simply to apply the paint without thought regarding the foundation surface.

It is just as important that the surface be in good condition as it is that we select a good grade of paint, for no matter how good the paint, the result will be far from satisfactory if some attention is not given to this very important detail.

In the first place, the surface to be painted must be clean, dry, and free from dust, grease and dirt. On new work, a thin coat of shellac should be applied to all knots and sappy places. On work that has been previously painted, use a wire brush to remove all loose particles.

Spots that are entirely bare, where the paint has been chipped off, should be given a priming coat of paint reduced with turpentine.

The extra labor in thus properly preparing the surface will be more than justified in the durability of the paint and the smooth, uniform appearance of the finished surface.

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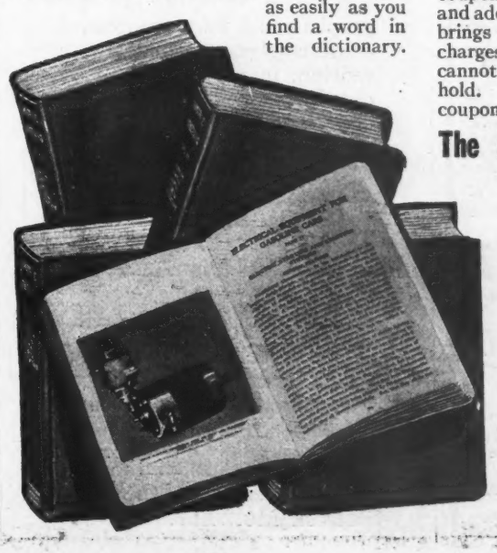

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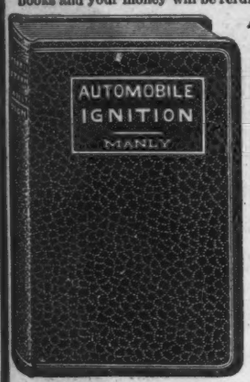

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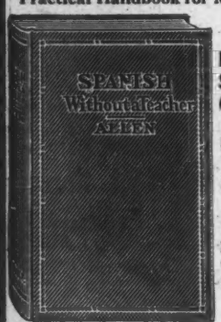

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Rules Governing the Contest

(1) Contestants are not limited to the number of methods of utilizing the exhaust which they may describe, but only one method can possibly win the first prize, only one the second, and only one the third. The contest is open to everybody.

(2) The method must be clearly shown either in a photograph or in a drawing. If a drawing is sent in, it need not be made by a skilled draftsman. It is sufficient that it should be intelligible. While pencil sketches will be considered, contestants are requested to make their drawings in ink on bristol-board. The views should be sufficient in number to set forth the use of the engine's exhaust very clearly. The contestant's name and address should appear on each sheet of drawings.

(3) The drawings or photographs must be accompanied by a description, preferably typewritten, in which the method is clearly given. It must be written on one side of the paper only, and it should not be more than 500 words in length. The name and address of the contestant should appear in the upper left-hand corner of the first sheet of the written description.

(4) The drawings and description entered by contestants must be received by the POPULAR SCIENCE MONTHLY not later than 5 P. M. on Friday, October 31, 1919.

(5) The judges of the contest will be the editors of the POPULAR SCIENCE MONTHLY.

(6) The first prize of $50 will be awarded to the contestant who, in the opinion of the judges, has suggested the simplest and best method of utilizing the exhaust of a gasoline engine.

The second prize of $25 will be paid to the contestant who submits a method next in merit.

The third prize of $15 will be paid to the contestant who submits the method third in merit.

(7) The winners of the contest will be announced in the earliest possible issue of the POPULAR SCIENCE MONTHLY. A description of the methods which win the three prizes offered will duly appear in the pages of the POPULAR SCIENCE MONTHLY, together with the names of the winners.

(8) The editors of the POPULAR SCIENCE MONTHLY shall have the right to publish meritorious manuscripts which do not win a prize. The regular space rates will be paid to the contestants who submit the manuscripts thus selected.

(9) When a contestant submits more than one method, the description and drawing by which each is set forth must be sent as a separate unit.

(10) Manuscripts or drawings will be returned to contestants if stamps are enclosed.

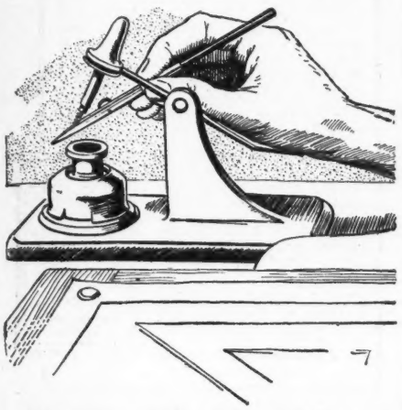
(11) Send drawings and specifications to the Engine Contest Editor, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York City.

This Novel Pen Inker Helps Keep the Sketch Clean

WHEN doing very fine lettering and mechanical drawing, it is often necessary to hold the work flat with the left hand. Every time the pen is to be inked, the stopper of the bottle must be removed and the quill touched to the ruling pen. This necessitates the use of the left hand, which interferes with the rapidity of the work and sometimes allows the work to slip, making an untidy job.

The illustration shows how the contrivance works; it is patented and can be bought cheaply.

It has a cast-iron base, with a place to hold a standard bottle of mechanical-drawing ink and an upright on which is hinged a cross arm. One end of the cross arm is shaped similar to the regular ink stopper, and holds a small piece of metal tipped with a closed coil spring. The spring will hold a small quantity of ink, which will run on to the pen when contact is made. The other end of the cross arm is flattened to form a rest.



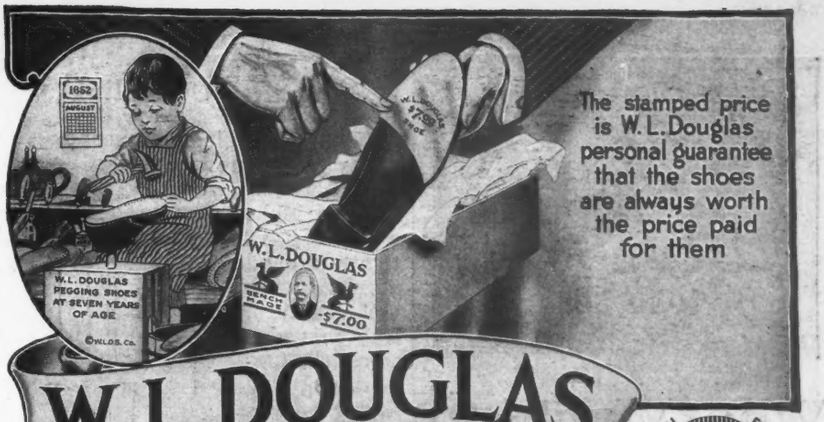
Place your wrist on the handle and the stopper rises, making the inking easy and clean

With the pen in hand the wrist is placed upon the rest, which draws the stopper from the bottle. The pen is touched to the spring and inked, and when the wrist is raised, the stopper drops back into the bottle by its own weight.—EDWIN G. GETTINS.

A Semaphore Signal to Summon Taxicabs

WHEN a telephone call, summoning a cab, is received in the offices of a taxi company in Illinois, the operator handling the order sets a semaphore on the outside of the building, by means of which a driver is summoned from the regular "stand," some 300 or 400 feet away. At night the semaphore shows a red light when calls are waiting.

This device permits drivers to remain at their posts, where there is most chance of picking up a fare, and at the same time be within a moment's call when they are needed in other parts of the city.—ORIN CROOKER.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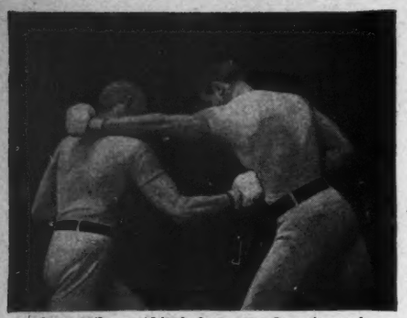

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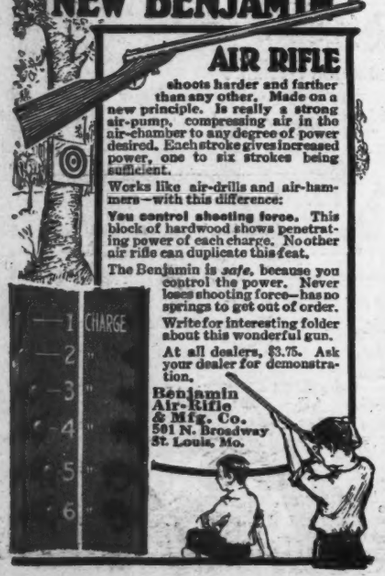
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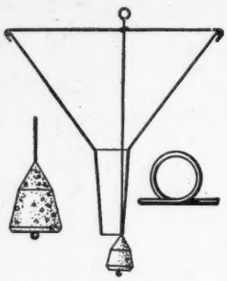
A Funnel Gage that Warns Against Overfilling

OBTAIN a piece of medium-stiff wire (bailing wire is good) about two inches longer than the top of the funnel. Make an eye in the middle by winding it tightly around a small wire nail one turn. Lay this wire across the funnel top, and slightly off center as measured along the wire—about half the diameter of the funnel tube is right. Then cut the ends just long enough to bend down into hooks which grip the funnel.



No more spilling of valuable fluid: the gage warns you when the receptacle is full

Take another piece of fairly stiff wire (broom wire, straightened out, will do nicely) two or three inches longer than the whole length of the funnel. Make a ring on one end to keep it from sliding through the other wire, and drop it down through the eye in the first piece.

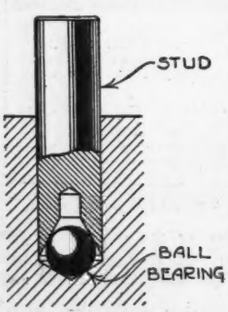
Now take a cork, small enough to slide down easily through the tube of the funnel, and punch a hole lengthwise through the center of it with a darning needle or awl. Pass the plain end of the broom wire through the cork, from the small end, and trim the cork to a cone shape as shown in the illustration.

Set the whole device in the funnel, and adjust the cork on the wire till its top is about one-fourth inch below the bottom of the funnel tube. Cut off the wire below and turn a slight hook in it to prevent the cork from slipping off.

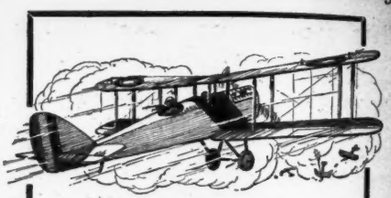
As the fluid rises in the receptacle it floats the cork, which raises the wire and warns you when the vessel is nearly full.—CHARLES A. PEASE.

Securing a Stud in a Hole with a Steel Ball

THE illustration shows an efficient means of securing a stud tightly in a hole. A hole is drilled in the end of the stud, with a combination drill, and countersunk. An ordinary ballbearing of a suitable size is dropped into the hole and the stud either screwed or hammered down upon it. As it will be seen, the bottom of the stud will be expanded by the ball, holding the stud tightly in the hole.—S. B. ROYAL.



The stud can't fail to seat firmly if this device is adapted



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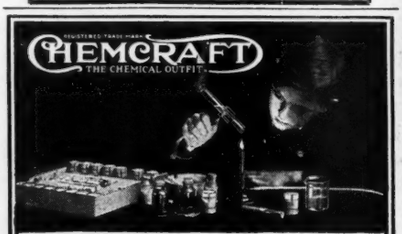

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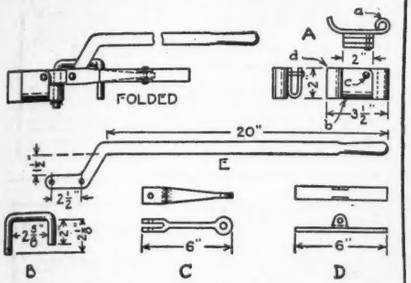
Floor-Layers' Clamp for Refractory Flooring

THE accompanying illustration shows, complete and in detail, a very useful tool for forcing crooked flooring into place, making tight joints and holding the flooring in place while nailing. The block *A* is made from stock 2 by 5/16 in., the two parts being riveted or, better, welded together. The hole *a* should allow a 5/8-in. rod to turn freely when inserted. The opening *b* should allow the lever *E*, 3/8 in.



Floor laying is a hard job at best. The tool shown helps make it an easier one

thick, to play freely. The hole *c* goes clear through, the front part clear, the back part tapped to screw the bolt into.

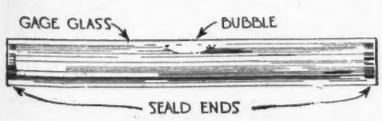
All bolts are 3/8 in. in diameter. The spur *d* should be about 1/4 in. shorter than would be necessary to bring the face of the block parallel with the joist. This swings the foot *D* enough to one side to free for nailing.

The yoke *B* is made of 5/8-in. round iron, the long arm being secured in the hole *a* by a cotter pin. The width given between sides is for use on ordinary joists, 2 in. thick. For thicker joists, this space will have to be enlarged accordingly.

The pitman *C* is made from 1 by 3/8 in. stock, the clip, which should take the end of the pitman without binding, being welded on. Two holes near the ends allow for screwing on the wooden facing, 1 in. square, if desired.—C. A. PEASE.

An Emergency Level for Builders

TAKE an ordinary piece of gage-glass, set a cork in each end, and fill the glass with water until just



A gage-glass filled with water and with a cork in each end makes a good level

enough air is left in to form a bubble. This bubble may be made as long as desired by adding to or lessening the water in the tube. A scratch should then be made, with a file, at the center of the tube. When tightly corked and laid upon the piece of work to be leveled it will do as good work as the store article.—GEORGE L. YASTE.

Make Your Mind a File—Not a Pile

Stop Forgetting

By Prof. Henry Dickson

PROF. HENRY DICKSON
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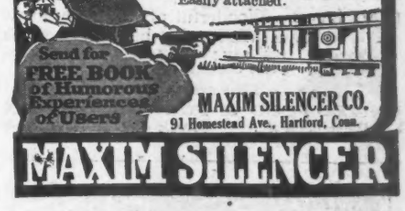

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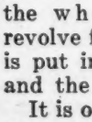

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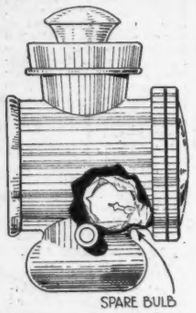
A Use for the Dash Lamp on the Ford

POSSIBLY not one half of the owners of Ford cars ever use the oil lamps that are located on each side of the wind shield. Keeping the lamps filled with oil, lighting them with a match every time you desire to use them, and extinguishing them after the journey is over is very annoying and consumes valuable time.



Wrap the electric bulbs in tissue paper and tuck them away in the dash lamp

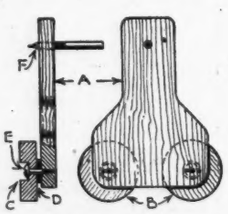
Still, there is a good use for these lamps. It is exasperating to burn out a bulb on a dark night, and it is doubly annoying to find that you have no extra bulb along. The problem has been the carrying of these delicate articles without breaking them and here is a suggestion that may help.

Take a piece of waste or soft paper and wrap up the bulb in it. Open the door of the oil lamp and place the bulb within. Here it will ride safely over all bumps, no matter how rough the road, and the bulb is always ready for use when the old one burns out. Two may be carried by using both lamps.—R. D. GALT.

A Shingle-Marker to Replace the Old Chalk-Line

CARPENTERS, when shingling, are obliged to make several trips across their staging to chalk up the line used as a guide for placing the shingles. The little device here shown obviates this.

A triangular-shaped piece of wood is made, as shown at *A*. Two wooden wheels *B* are made and bored, part way through, as shown at *C*, to allow the screw *E* to set flush. A washer *D* is put in place and the screw *E* set so that the wheels revolve freely. A carpenter's pencil *F* is put in place at the proper distance and the device is complete.



A shingle-marker that is better than the chalk-line

It is operated by placing the wheels against the heel of the last row of shingles laid and moving the frame along, with the pencil marking as it goes.

In this way two or three trips across the roof are saved, as a single journey from end to end of the roof completes the marking process.—ALBERT E. JONES.

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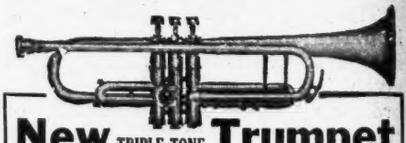

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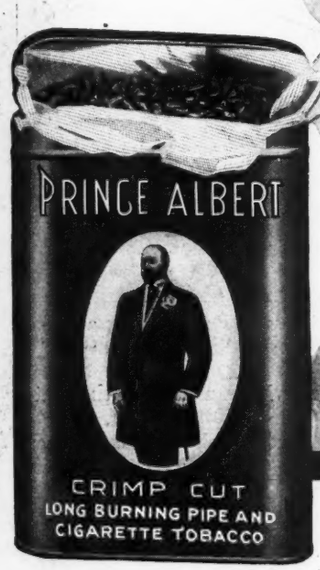

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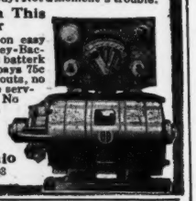

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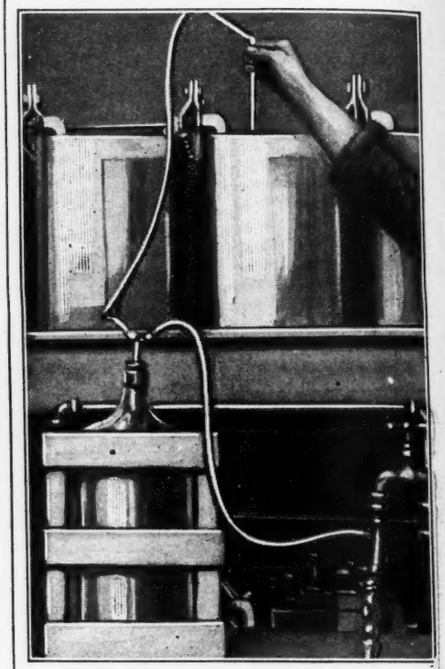
Removing Sediment from Storage Battery Cells

HAVING been in rather severe service for four years, the cells in the storage battery of the Johns Hopkins University reached a condition where a thorough cleaning was necessary. Active material had fallen from the plates into the bottom of the jars



An effective scheme for cleaning a storage battery without taking out of service

until it was within a little of the plate bottom.

There were 130 cells in the set, each of 400-amp. hr. rating. The jars were of glass and measured 12 ins. square and 16 ins. high. How to remove the old active material from the bottom of the cells was an awkward problem. To dismantle the cells, take them down and wash out the sediment was out of the question, for, aside from the risk of breaking the jars, expense of new separators, etc., the battery could not be taken from its work.

An attempt was made to suck up the sediment using a rubber pump and a long suction pipe. This worked but it was too slow and finally the pump broke.

Other schemes were used but the one that finally worked is best described with the aid of the illustration.

The apparatus consisted of a filter pump, a 5-gal. (19-1) bottle, a Z-shaped glass tube and a length of rubber tubing. Any other type of exhaust pump can be used satisfactorily to produce the vacuum, if desired.

The water was turned on at the filter pump, causing a partial vacuum in the bottle. By inserting the glass tube in the battery jar the sediment was drawn up. As the process went on the end of the glass tube was moved about over the bottom of the jar and all the sediment was thus removed.

Of course, the acid level in the jar was lowered during the cleaning process, but as the cells were not in service while the battery was being worked upon this made little difference. They were refilled with electrolyte before heating could take place. The mixture taken from the cells was emptied into a spare battery jar and allowed to settle. The clear electrolyte was siphoned off and used for refilling the jars.

The time required for each cell was exactly half an hour. Six or eight cells were cleaned per day, according to the time available.—M. W. PULLEN.

A Sprinkler Attachment for Garden Irrigation

IN slow and continuous irrigation of garden plots, which is preferable and more effective in producing sure and steady growth to spasmodic waterings, trouble has always arisen because the gasket in the pipe or hose line soon wears out and the pressure varies so that results are uncertain without constant watching. Here is a way to prevent this trouble.

The device, which is easily made by anyone, consists of a large but short copper rivet with a 1/16-in. hole punched or drilled through it lengthwise, and two ordinary rubber washers, one to be fitted over the head of the rivet and the other under it in the coupling.

Washers hold the rivet in place and prevent leakage when the hose is attached to the hydrant and the joint screwed tight. The faucet may be turned on full and the pressure is relieved from the gasket and hose.

The stream is distributed with a 3/8-in. pipe, 10 ft. or more in length, with a 1/16-in. hole in it every 2 ft. At one end this pipe is fitted with a

The washers hold the rivet in place and prevent any leakage at this point

reducer and coupling to connect with the hose, and the other is capped. There will be no variation in the streams that come from the holes in the pipe, they are not strong enough to cause soil erosion, and the pipe may be placed wherever desired, with the water running. This size stream cannot injure the plants even though the water may be turned on full.—JOHN L. VON BLON.

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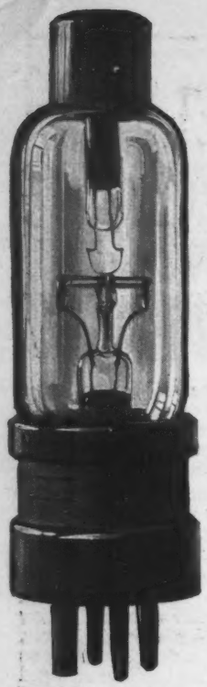


What the Germans think is high class in a vacuum tube. This one was captured aboard a German submarine

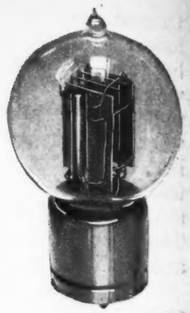
The Thermionic Detector

By H. J. van der Bijl, M.A., Ph.D.

THE following is probably the most complete and thorough-going popular exposition of the theory of that interesting new piece of apparatus, the thermionic detector, or vacuum valve, which has yet appeared. It follows up the historical article which appeared in the August POPULAR SCIENCE MONTHLY. Dr. van der Bijl is a research physicist and engineer of much experience, specializing in thermionic detectors and related apparatus for several years, especially during the war. He is the author of a number of papers in the Proceedings of the Institute of Radio Engineers and in several other purely professional journals, all of high standing.

Each of these papers, however, is full of calculus and other mathematics, hard for all but the initiated to follow. Knowing the interest on the part of amateurs at this time in vacuum tubes, we asked Dr. van der Bijl to set down in a more easily understood and popular way some of the things he knows. He has produced an unusual article.

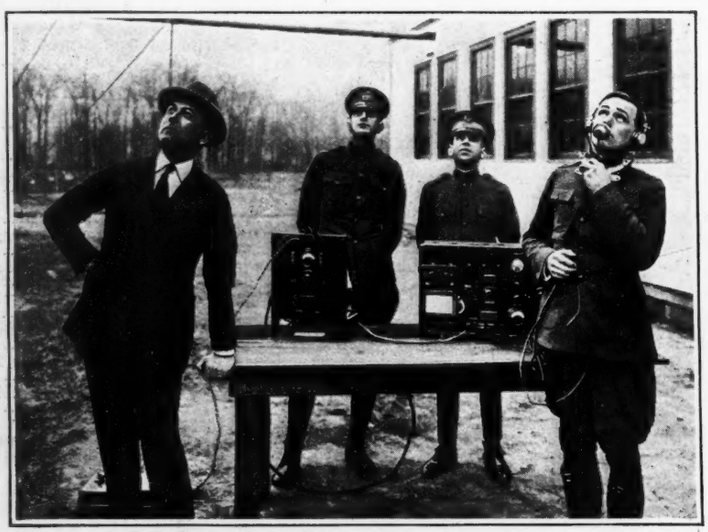
A second instalment, relating to the practical manipulation of thermionic detectors, will appear in an early number.—EDITOR.



An American vacuum tube. A dozen or more different kinds are produced in the United States. Most are distinguished for compactness, accurately worked-out characteristics, and dependable operation

THE art of radio communication owes a great deal of its recent remarkable development to the thermionic vacuum tube. This device is capable of performing a large number of functions. It can amplify telephonic currents with great precision, detect high-frequency electrical oscillations and make them audible, and produce oscillations or "sing" at almost any desired frequency. While it operates with facility over a wide range of frequencies (its present singing register ranges from a fraction of a cycle per second to several million cycles per second), the range of power that it can handle is no less remarkable, considering that it detects oscillations the power of which is a small fraction of a watt, and can be made to produce oscillations representing a power of a thousand watts and more.

In practically all radio receiving sets in use at the present time, the crystal detector has been superseded by the thermionic detector, which is more sensitive. As time goes on, the radio experimenter will realize the growing need of a working knowledge of the thermionic tube. This knowledge can be acquired without much trouble by those who know something of the behavior of electrons and are acquainted with some of the fundamental principles underlying electric wave phenomena. The man who understands how and why the thermionic tube operates the way it does will be able to operate his tube under the best conditions and get the most out of it. Let us, therefore, briefly consider some of the fundamental principles involved in the study of this tube.



Telephoning to a plane high in the air—one use for thermionic detectors, or vacuum valves. A similar set on the airplane permits the aviator to hear and answer

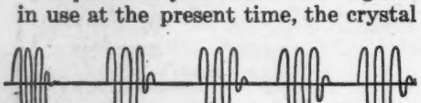


FIG.1 Train of oscillations received by antenna

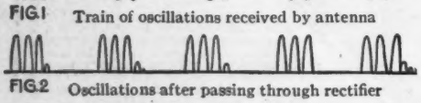


FIG.2 Oscillations after passing through rectifier

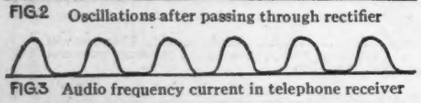


FIG.3 Audio frequency current in telephone receiver

Curves demonstrating fundamental action of crystal detector. Complete story is shown

Crystal Detector Acts as Rectifier

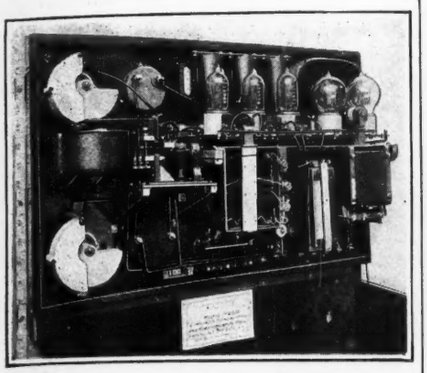
The crystal detector can detect electrical oscillations because it acts as a rectifier; that is, it transmits current readily in one direction, but practically none in the other. Fig. 1 shows a train of electrical waves such as is obtained from a source of continuous oscillations and interrupted at definite intervals.

Suppose these waves be picked up by a wire and passed through the coils of a telephone receiver. If the frequency of a current passing through a receiver lies within the audible range, the receiver gives a tone, because the diaphragm is attracted by the electromagnet so many times a second. But the waves used in radio work are of such a high frequency that they cannot be heard at all. Now suppose we chop off all the lower halves of the waves shown in Fig. 1, so that we have something like that shown in Fig. 2. There will then be a succession of current rushes through the receiver always in the same direction. The intensity of these current rushes, occurring, say, every hundred thousandth of a second, increases rapidly and then dies out. If this process recurs every thousandth of a second, the effect on the receiver is the same as if a current like that shown in Fig. 3 passes through the receiver a thousand times a second, and the receiver produces an audible tone.

This chopping off of the waves is what the crystal detector does. The early type of thermionic valve of J. A. Fleming can also be made to detect in this way, and in the early days was so used. But it has other characteristics which enable it to be used in a different way. This valve much resembles an incandescent lamp. But, besides the filament, it contains a plate which sometimes takes the form of a metallic cylinder surrounding the filament and sometimes is in the form of a plate or pair of plates.

The discovery was made by Edison in 1883 that if the positive end of the filament of an incandescent lamp is connected through a galvanometer to a plate in the bulb a current is observed to flow through the galvanom-

eter. But when the plate is connected to the negative end of the filament there is little or no current. The same effect can be observed with the circuit shown in Fig. 4. Here the battery E_f heats the filament, and the current between filament and plate is driven by battery E_p. This current is observed to flow when the plate is positive with respect to the filament even in the highest attainable vacuum,



Rear view of right-hand part of radiotelephone set shown on page 132. Notice how the valves are mounted

and is carried by electrons emitted from the filament when it is hot. In order to operate a thermionic tube satisfactorily it is necessary to know how, why, and under what condition the electrons can be boiled out of the filament.

Relation Between Electrons and Atoms

The atoms of all substances consist of a number of electrons held together by positive nuclei. The difference in the various elements consists in the number and arrangement of the electrons and positive nuclei. Metals behave as if they have a large number of electrons that are free to move between the atoms, and therefore they are good conductors of electricity, because if a potential difference be applied between the ends of a bar of the metal the electrons move in the direction of the electric field and so constitute a current. Although these electrons are free to move between the atoms of the metal, they cannot escape from it at ordinary temperatures because they are constantly pulled back as soon as they try to reach beyond the surface of the metal. The force tending to pull them back is sufficiently strong to do so, except when the electrons do not shoot out from the surface with a very high velocity. If their velocity exceeds a certain amount the force fails to hold them within the substance and they escape.

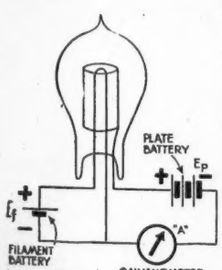
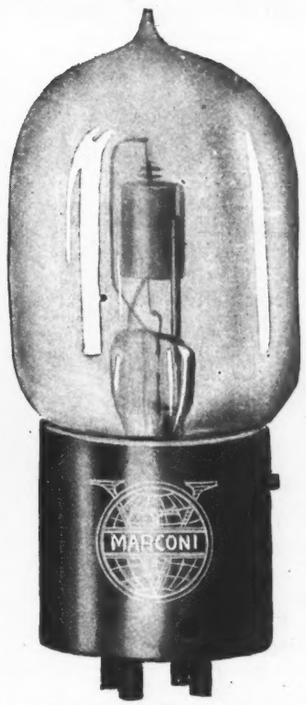


FIG 4

Showing the principle of Edison's vacuum valve discovery

THE HEART OF THE WIRELESS



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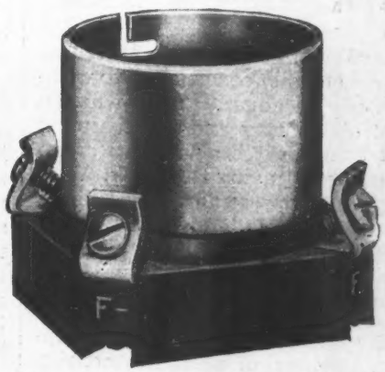

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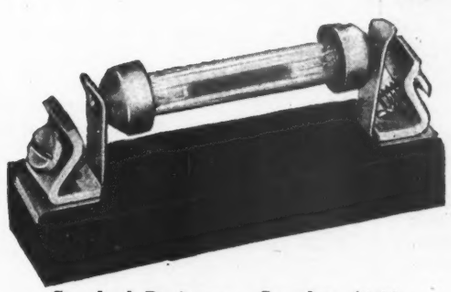

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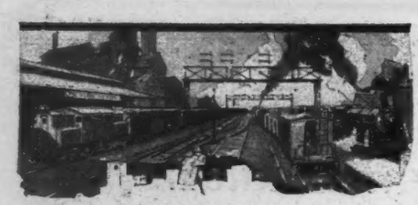

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Now, how can we give the electrons sufficient velocity to get away from the substance? These electrons, like atoms, are in a state of constant motion, and they move around with a wide range of velocities, which constantly change on account of the collisions of the electrons with one another and with the atoms of the substance. At any instant a few electrons will move with very high velocities, a few others will move with very low velocities, and the rest will possess velocities ranging between these two extreme values. There is one velocity which is shared by more electrons than any other. This is the most probable velocity, and when we talk of the "velocity of the electrons" we shall in general mean this value.

Now, the velocity of the electrons depends upon the temperature of the substance. At ordinary temperatures the velocity is so small that practically no electrons can escape from the substance. But we can easily enable them to do so by heating the substance to a high temperature. Thus a tungsten filament at the temperature it has in an incandescent lamp, or higher, is hot enough to boil out large numbers of electrons. Suppose we heat the filament in Fig. 4 to such a temperature. Then, on account of the potential difference between the filament and the plate, the emitted electrons are pulled over to the plate and a current flows through the circuit. The electrons, of course, flow in a direction that is opposite to the generally assumed direction of current.

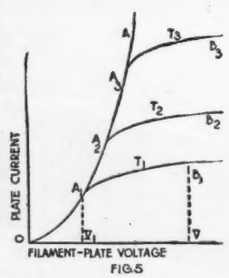
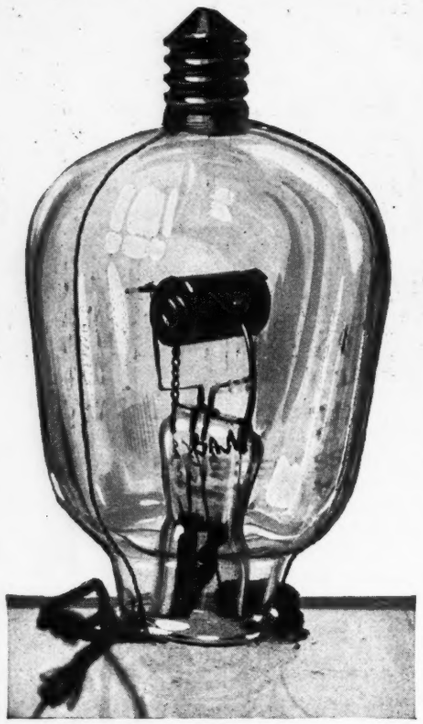


FIG.5

Peculiarities of current conduction through simple 2-electrode tube

The peculiarity of the current conduction through such a tube is that the current does not increase linearly with the applied voltage, as it does in the case of conduction through a wire. While the voltage between filament and plate is small, the current at first increases slowly, and then gradually more rapidly as the voltage is increased, until finally it does not increase in any marked way, no matter how high the voltage is made. These phenomena are represented by the curve OA_1B_1 in Fig. 5. The current represented by the magnitude VB_1 is therefore very nearly the maximum current that can be obtained from the tube when the filament is at a temperature T_1. But we can increase this current by raising the filament to a higher temperature, because this would increase the velocity of the electrons and more would escape from the filament. At a filament temperature T_2 we then obtain a characteristic OA_2B_2.



An English vacuum valve. Haste and rush of the war necessitated rough construction. Later valves are improved

The maximum current that can be passed through the tube is called the saturation current, and is obtained when the electrons are pulled away to the plate just as fast as they are emitted from the filament. From this it follows immediately that when the voltage is not high enough to give the saturation current, then we do not make use of all the electrons that are boiled out of the filament.

Crowding the Space with Electrons

What happens to those that are not pulled over to the plate by the applied potential difference between filament and plate? Well, they go right back to the filament, when they are not needed. Of course, they come out again, and so there is a continual movement back and forth, while at the same time some of the electrons are continually being carried away by the applied electric field. It might seem strange that some electrons should suddenly change their minds and return to the filament. The reason for this is that electrons, being negative electric charges, always repel each other, and they get so badly crowded in the space around the filament that some are driven back to it.

This crowding of the space with electrons accounts for the peculiar shape of the curve OA. If just a few electrons came out of the filament they would easily move across to the plate; but when they come out in big crowds it is necessary to apply a voltage be-

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tween plate and filament to get them across. A few persons running down a quiet street can go at a pretty good speed; but when the street is full of people trying to see a parade, the police can't make them go fast enough. The same illustration applies to electrons. Increasing the number of people would not make them move any faster. This is true also of electrons in the thermionic tube.

Suppose we apply a voltage equal to OV_1 between the plate and filament (Fig. 5), then the current is given by V_1A_1. This is a measure of the number of electrons that this voltage can pull over to the plate per second. And we see that this number is the same, no matter how many more electrons we boil out of the filament by raising its temperature. The only condition is that the temperature of the filament must not be appreciably less than that corresponding to T_1. If the temperature is equal to or greater than T_1, the space between the filament and plate is crowded as full of electrons as it can be. Of course, we can drive more electrons across the space by increasing the driving force; that is, we can increase the current by increasing the voltage.

Fig. 6—A modern vacuum valve of typical three electrode construction

The fact that electrons behave somewhat like a crowd of people is in many respects a great disadvantage. One reason is that it requires an expenditure of energy to get them across the space; another is that the crowding causes the characteristic to be curved. When using the tube as an amplifier it is desirable to have a straight characteristic. On the other hand, when using it as a detector we should like to have it curve as much as possible, because in this case we actually make use of the curvature of the characteristic.

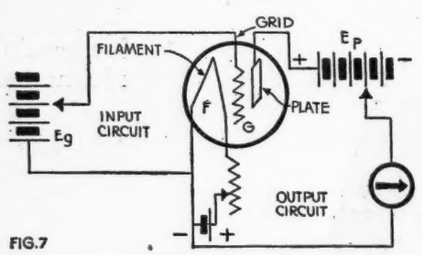

FIG.7

How to obtain the characteristics of the three-electrode vacuum valve. The apparatus used is simple

Controlling the Electron

Before showing how this can be done, let us first explain a much better way of pulling the electrons across, and of controlling the number that can pass to the plate per second. This can be done by inserting a third electrode in the form of a sievelike electrode or grid between the filament and the plate, as was done by De Forest in his "audion." A three-electrode tube is shown in Fig. 6, in which two flat plates are placed on either side of the filament and two grids intermediate between the filaments and the plates. The pairs of plates and grids are each connected metallically, to act like one plate and one grid.

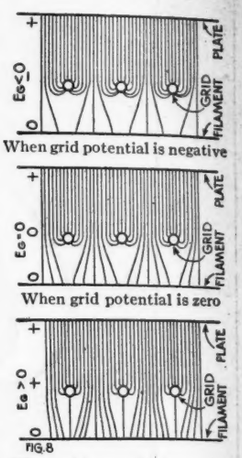

FIG.8

What happens when grid potential is altered. Looking down on cross-section of the grid, plate, and filament

The insertion of the grid or controlling electrode in the valve was a step of tremendous practical importance. The grid makes it possible for the tube to perform a great variety of functions. The characteristics of the tube can be obtained with a circuit like that shown in Fig. 7. It will be seen that there are really two circuits: the input circuit, connecting the grid to the filament; and the output circuit, connecting the plate to the filament. The battery E_p keeps the plate positive with respect to the filament, and drives the electrons emitted from the filament across the space to the plate.

The number of electrons passing to the plate can be controlled by potential variations applied to the grid. The grid acts like a partial screen to the electron flow. But the screening action depends not so much upon the interposition of the wires in the path of the electrons as upon the attracting and repelling effect of the grid due to the positive or negative potential applied to it. The effect of the grid can be exemplified by the lines of force diagram shown in Fig. 8.

Two Examples

Let us suppose that the negative end of the filament is connected to ground and the plate maintained at a positive potential by means of the battery E_p. Then a certain number of lines of force issue from the plate. Now, if the battery E_g be zero for the present, that is, if the grid be directly connected to the filament, then there can be no lines of force directly between filament and grid. The distribution of the lines of force is then that shown by the central diagram.

It is seen that the electric field, due to the potential on the plate, reaches

through the grid and manifests itself between filament and grid, and that therefore some electrons will be pulled to the plate through the openings of the grid, but not so many as would be the case if the grid were removed. If now we make the grid somewhat positive with respect to the filament by means of the battery E_g, the electric field between filament and grid will be increased; there are more lines of force in that region, as is shown by the lower diagram Fig 8. The result is that more electrons will be pulled over to the plate per second and the current increases.

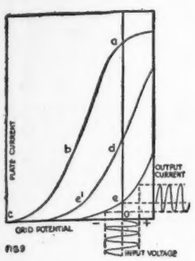

FIG 9

Curves obtained by keeping plate voltage constant and varying grid

If, on the other hand, the grid be made negative with respect to the filament, it tends to repel some of the electrons and the current to the plate decreases. It can be still further decreased by making the grid still more negative; and by making the grid sufficiently negative we can stop the flow of electrons to the plate altogether. It will be seen, then, that the current to the plate can be varied by simply varying the potential of the grid, even though the potential of the plate remains constant.

It is important to note that when the grid is negative it tends to repel the electrons that are emitted from the filament, while the plate, being positive, tends to pull the electrons away from the filament. As long as the repulsion of the electrons by the grid is not greater than or equal to the attraction due to the plate, electrons will pass to the plate and a current will flow through the tube. But, since the grid is negative, the electrons will all go to the plate and none to the grid. This is the same as saying that the resistance of the input circuit is infinite—it is an open circuit. If, on the other hand, the grid has a positive potential with respect to the filament, some of the electrons emitted from the filament will actually be pulled over to the grid, and a current will flow in the input circuit as well as in the output circuit.

When the grid is at the same potential as the filament the number of electrons going to the grid will be very small—in fact, usually negligibly small compared to the number going to the plate. The fact that the plate current can be controlled by potential variations on the grid without the grid taking any current *is an important property of the thermionic tube.* When there is no current in the input circuit there is no power expenditure in that circuit. It therefore means that we can vary the current in the plate circuit without doing any work.

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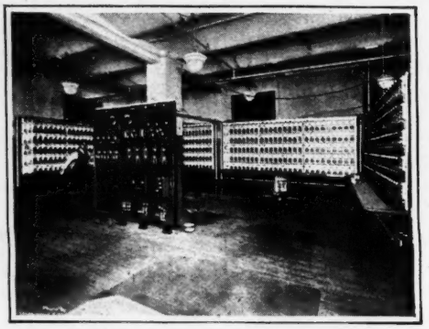
In practice this is not quite true, because there is always a small amount of power wasted in apparatus included in the input circuit, such as induction coils. Of course, this device is not a perpetual-motion machine. Although we can obtain comparatively large current variations in the plate circuit by expending a very small amount of power in the grid circuit, still the force that drives the current through the plate circuit is the plate battery E_p, so that this battery supplies the necessary energy.



Rack for life tests on vacuum tubes. Thousands of tubes were manufactured during the war

Let us now see how the current-voltage characteristic curves of the three-electrode tube compare with that of the two-electrode tube shown in Fig. 5. In the first place, we note that the main difference between the two tubes is that one contains a grid between the filament and plate, and the grid acts like a screen to the electron flow through the tube. If we keep the grid at a constant potential with respect to the filament (zero potential in this case) and measure the current to the plate for increasing potential on the plate; then we obtain curves that look very much like those shown in Fig. 5, except that for the same voltage between filament and plate the current to the plate is smaller. If the grid, instead of being at the same potential as the filament, be maintained at a negative potential by the grid battery, the curves will be shifted to the right, because the repelling effect of the negative grid on the electrons makes it necessary to apply higher plate voltages in order to get the same number of electrons across to the plate.

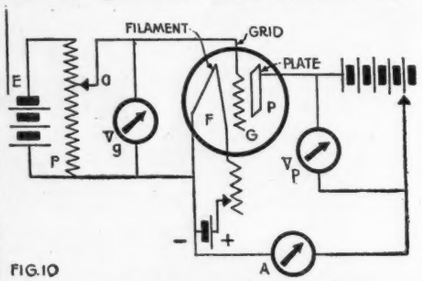


FIG. 10

Circuit for obtaining the amplification constant of a vacuum tube—a very important figure

Further Tube Characteristics

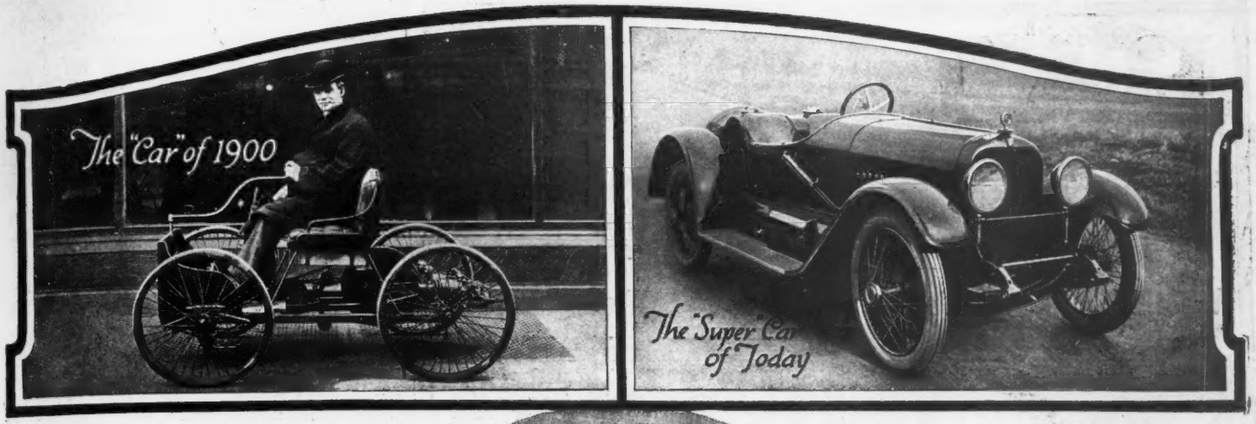
Now, there is another set of curves that can be obtained with this type of tube by keeping the plate battery voltage constant and varying the voltage of the grid battery. See Fig. 9. When the grid is at the same potential as the filament, there is a current flowing through the tube, because the plate is at a positive potential which drags the electrons through the grid to the plate. This current is represented by the magnitude *oa*. If the grid be given, by means of the battery E_g (Fig. 7), a negative potential with respect to the filament, the repelling action of the grid counteracts the attraction due to the plate, and the plate current is less than before.

As the negative grid potential is increased the current decreases continuously, as is indicated by the line *abc*. When the point *c* is reached the repulsion due to the grid equals the attraction due to the plate, so that the plate current is reduced to nothing. If the plate had a lower potential to start with, the curve *de'* would be obtained. It looks very much like the curve *abc*, but lies to the right of it.

For a still smaller plate potential we get the curve *e*. These curves resemble the one given in Fig. 5. There is, however, this important difference: that a change in the grid potential produces a larger change in the plate current than an equal change in the plate potential. The ratio of the change in the plate potential to the change in the grid potential that give the same change in the plate current is called the amplification constant of the tube. This is a very important constant, and can be measured very easily in the following way:

Suppose the plate battery has a voltage of fifty volts and the grid potential is the same as that of the filament. Then there is a certain current flowing through the tube. Let the plate voltage now be increased to, say, sixty volts. This has the effect of pulling more electrons away from the filament to the plate, so that the current increases. But the current can be brought back to its original value by making the grid sufficiently negative with respect to the filament. If this negative potential is found to be one volt, then the amplification constant of the tube is ten. This can be conveniently done with the circuit arrangement shown in Fig. 10.

The voltage of the plate battery can be measured with the voltmeter V_p, and the current with the current meter A. By connecting the battery E to a slide wire resistance, *r*, the voltage between the filament and grid, which can be measured with the voltmeter V_g, can be adjusted in very small steps by sliding the contact *a* until the change in current produced by a change in the plate potential, and indicated by A, is exactly neutralized. In commercially used tubes the amplification constant ranges from about five to about forty,



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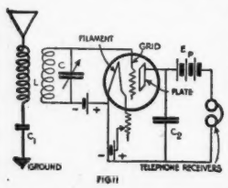
and sometimes more, depending on the purpose for which the tube is used.

The plate voltages used on commercial tubes cover a very wide range, and so do the currents that pass through them. In the case of tubes used as radio detectors it is not necessary that the current be large, because here we are dealing with very small quantities. Many detector tubes operate satisfactorily with something like twenty volts or less on the plate, and the plate current is usually a small fraction of a milliampere. On the other hand, tubes that are used as amplifiers on telephone lines usually operate on a plate voltage of about one hundred and fifty volts, with a current of several milliamperes. Then again, tubes that are used as radio transmitters need plate voltages of several hundred and sometimes several thousand volts, the plate current being sometimes as high as several amperes. This shows what a tube is capable of.



How a three-electrode tube is applied to radio circuits

Let us now see how it is possible to make use of the curvature of a tube's characteristic to detect high-frequency electromagnetic oscillations. A simple type of detector circuit is shown in Fig. 11. The incoming oscillations are picked up by the antenna, and are induced in the circuit LC. The condenser C is variable, so that it can be adjusted until the circuit LC is in resonance with the antenna circuit. (The inductance L can, of course, also be variable if necessary.) We then obtain the highest possible alternating potential difference between the grid and the filament. These potential differences can be superimposed upon the constant voltage of grid battery inserted in grid circuit. But when using the tube as a straight detector the grid battery can usually be omitted.

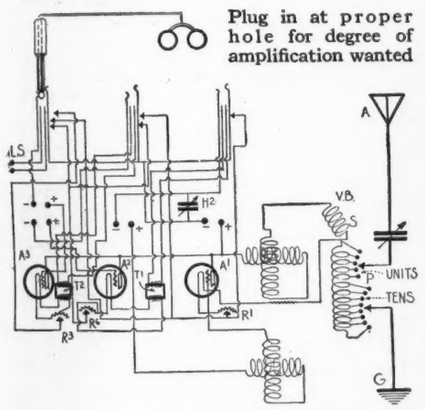
Suppose, then, that the plate battery voltage is so adjusted that the current for zero grid potential is given by O_e (Fig. 9). The incoming oscillations from the antenna then make the grid alternately positive and negative. The current in the plate circuit therefore alternately increases and decreases. Now suppose the potential variations impressed on the grid by the incoming oscillations be represented by the wavy line shown below O. This causes the plate current to vary in the manner shown by the wavy line to the right of the curve. Now, it can be seen that the difference between those two wave curves is that the voltage wave is symmetrical; that is, the positive peaks are just as large as the negative peaks, but the current wave is lopsided, and the effect produced by the tube is similar to that produced by the crystal detector, as shown in Figs. 1, 2, and 3. In other words, audible current flows through telephone receiver.

Try a Little Wireless on the Trees in Your Yard

ON page 83 of the July issue, POPULAR SCIENCE MONTHLY told in detail how Major-General Squier, Chief Signal Officer of the Army, had successfully experimented with "tree wireless." Here we show James V. Candido and a youthful friend from

Mounting the vacuum tubes in the set. Circuit used is shown below in detail

Brooklyn, N. Y., trying out the idea for themselves. They consider that it is a most interesting line of experiment and opens up many possibilities. Fully as good results can often be obtained with a tree as with an expensive aerial. Besides, one is investigating the unknown. There are many



The set has three vacuum tubes; two small transformers; wing, grid, and aerial circuit variometers; and balanced condensers at the points shown

queer twists to the possibilities. Listen to the following abbreviated excerpts from a paper that General Squier recently read before the Franklin Institute:

Dr. Charles P. Steinmetz, Chief Consulting Engineer of the General Electric Company, has said that, "The world needs men who know something of electricity, of the operations and control of electrical power. It needs men more every year, its very existence depends on the electrician."—*Electrical Experimenter, June, 1919.*

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We may regard the nail driven in a tree as a potential earth-terminal for the study of potential distribution on the surface of the earth itself. This earth terminal is always subject to changes of potential. Radiotelegraph or radiotelephone waves cause this, as well as electrical disturbances, which are always present on the surface of the earth or in the atmosphere above.

Tuned electrical circuits, suitably connected to the nail electrode, enable us to select from the composite waves received, one or more of the different frequencies for particular study, just as with color screens we can select a particular component of white light, and deal with it. We may even run a highly insulated conductor into the laboratory from the nail in the tree, and connect it to the modern vacuum tube, and amplify almost at will the particular effects we are studying. This tube is a valuable and new instrument of research for the modern laboratory. Tube and tree together form a powerful instrument for the study of fundamental problems of the earth itself as a charged sphere.

The ground required for tree telegraphy is simple. Merely spread out wires or chicken netting in the grass. Bury them under surface if you like

At right: Hooking up the apparatus preparatory to receiving messages from all directions. All kinds of hook-ups are possible

Connecting the aerial "lead" to the nail in the tree. Naturally, the wire may be run inside a laboratory, if kept carefully insulated, same as any other aerial connection of the kind. But working this way gets you outdoors—and besides that you can test the efficacy of different kinds of trees

Oscillator Patent Rights Decision

THAT J. A. Fleming of London, England, was the original discoverer of the radio-receiving functions and possibilities of vacuum valves was decided some time ago by the courts. But that the owner of his patents, the Marconi Company, is also to have the rights for the *transmitting* capabilities was only recently affirmed.

The suit was finally terminated in July. The following excerpts from the decision by Judge Mayer of the United States District Court, Southern District of New York, make clear the dominant technical points adjudicated by the case. The decision is very fundamental to the whole radio industry, and—besides the interest to radio men from this angle—the case also gives a good idea as to the kinks and quirks there are in law as far as inventors are concerned. Most radio men are inventing, or thinking about the possibilities of inventing, at the immediate moment.

The effect of the original decision of this court, as affirmed by the Circuit Court of Appeals, was to accord to Fleming's receiver invention a high place in the art.

Eight or nine years after the date of this Fleming patent—the exact dates are unimportant—Armstrong, Hogan, Waterman, Weagant, and probably other experts in the radio art, while using these devices as radio-wave detectors, independently observed that the detectors possessed the function of oscillating, or, in other words, of generating radio waves.

This was an extraordinary additional property or function of the so-called incandescent lamp detector—of which Fleming had no knowledge.

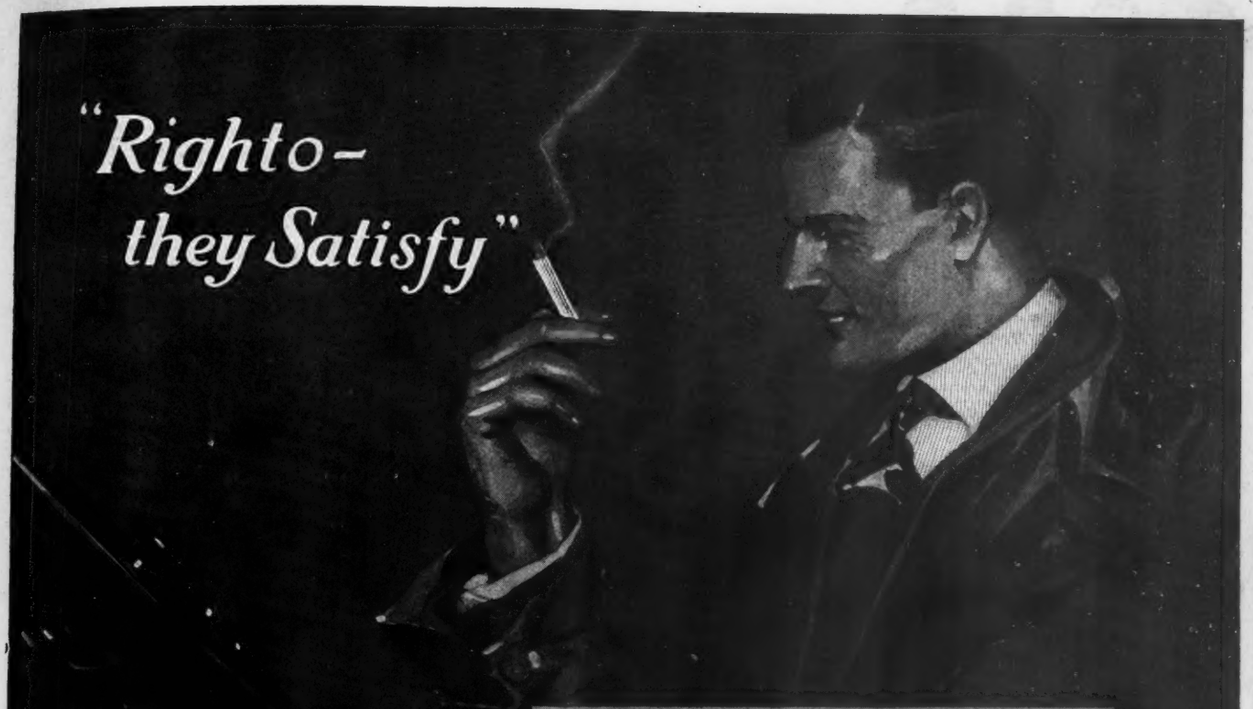
While his original claim covers broadly the device when used in the radio art, yet when read with the context of the specification it is plain that Fleming's disclosure was addressed to use of the instrumentality as a detector only.

It is, however, a principle of the patent law—so well settled as not to call for citations of authority—that a patentee is entitled to all of the benefits of his invention, whether or not known to or foreseen by him. . . .

On preliminary impression there is reluctance to extend the patent to an unexpected characteristic only observed after a considerable lapse of time by the highly skilled men who are students in the art. Yet, after all it was Fleming who made this remarkable contribution of a wholly new device, which of itself and in its development has done so much toward the practical advance of this great art. . . . .

It is concluded, therefore, that the so-called oscillion of defendant infringes and that the decree heretofore filed should be extended thereto with costs.

Submit the decree accordingly.



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Receiving Six Hundred Words a Minute

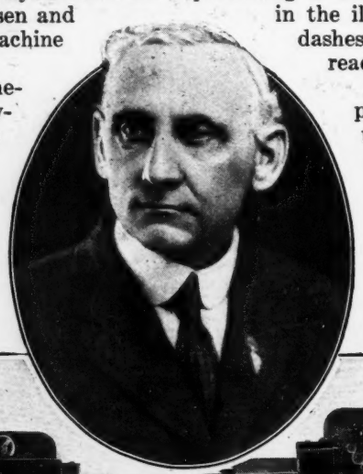
RADIO men have dreamed often enough of a machine that would record all that they hear on an aerial as fast as it comes in. To have such a machine seemed the ultimate a man could desire. But always some technical difficulty has arisen and prevented such a machine from being evolved.

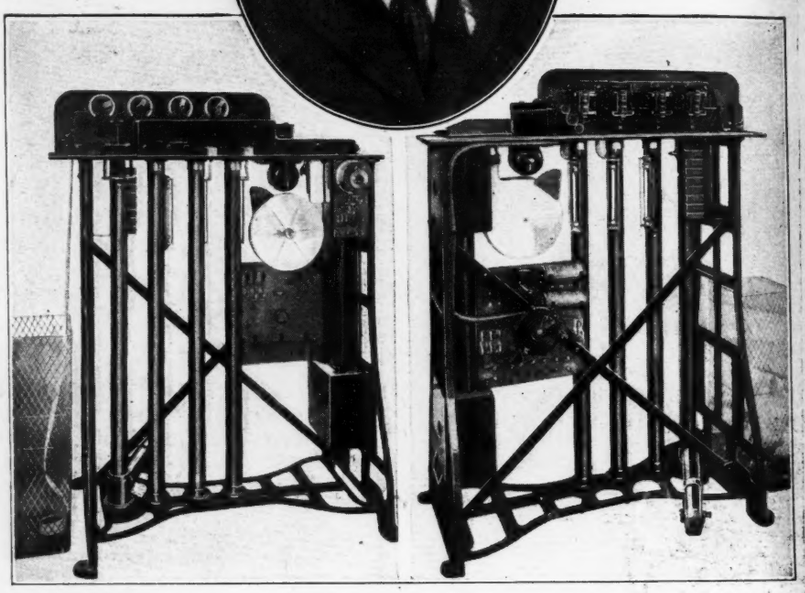
C. A. Hoxie, of Schenectady, N. Y., however, seems at last to have produced the machine desired. For some months during the latter part of the war it was in daily practical operation at the Government receiving station at Bar Harbor, Maine, and plans are developing for other use. With this machine a totally deaf man can receive, even up to six hundred words per minute; for the record produced is photographic and therefore visual.

Patents have not as yet been granted on the machine, or it would be possible to give mechanical details in full. The Government controls it at the moment, however. In substance, though, an electromagnetic mirror "flutters" in tune with currents coming from the aerial, thereby rapidly vibrating a tiny beam of light. This affects a passing strip of photographic tape, producing a record like that shown in the illustration. That the dashes and dots are easily read is evident.

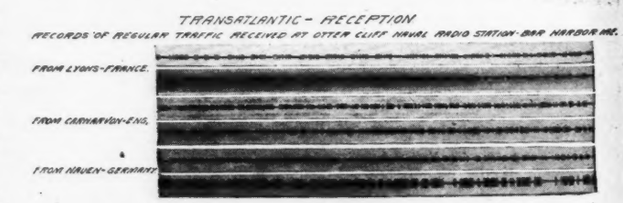
With this machine it is possible to receive immense quantities of messages each day from overseas between 4 A. M. and 10 A. M., the most favorable, and comparatively static-free, time for transmission. Average reception at present runs but fifteen or twenty words a minute. The change to the machine is capable of working wonders. It does well even under static.

Aside from the tape record, it is also possible to see on a ground-glass a fleeting visual image of the message coming in as fast as it appears. One may also listen with receivers in the usual manner. Sharp tuning permits several machines to operate on one aerial, each recording a message.





C. A. Hoxie and two views of his radio recorder. The long vertical tubes contain developer for bringing out the message on the tape after it has been acted upon by light from the tiny mirror. The mirror vibrates in response to currents set up by the rapidly incoming radio waves


TRANSATLANTIC - RECEPTION
RECORDS OF REGULAR TRAFFIC RECEIVED AT OTTER CLIFF NAVAL RADIO STATION BAR HARBOR ME.
FROM LYONS - FRANCE
FROM CARNARVON - ENG.
FROM NAUEN - GERMANY

Sample record produced by the machine. Six hundred words a minute are possible, 36,000 an hour. Imagine such a speed!

THIS ends our radio section for this month. In later issues—van der Bijl, "Practical Manipulation of Vacuum Valves"; Edison's notes on "The Earliest Years of Wireless," with much comment and information of historical importance; John Hays Hammond, Jr., on "Airplane Radio-Surveying and Mapping"; and many other items concerning the wholesale experimentation amateurs and professionals are carrying out and the noteworthy results they are getting.

What do YOU know that is new and interesting in radio? Send us your ideas, with pictures—plenty of pictures—and all the diagrams you can think of that will help to make the idea entirely clear. We pay for acceptable contributions.

What to Do to Avoid Automobile Engine Trouble

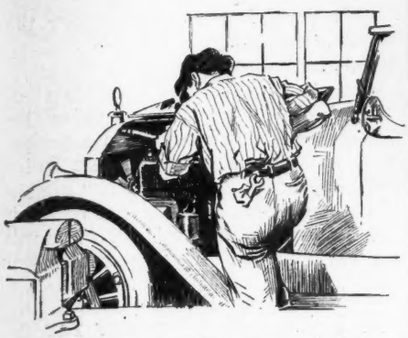
IF you want to get enjoyment and comfort out of your car you must take care of it as you would a fine horse. Therefore you must:

Not race the engine unnecessarily.

Have your ear tuned for every unusual noise. If it is a squeak locate and lubricate the part. If it is some other noise find the loose part that causes it and tighten it right away.

Not keep tinkering about the engine when it isn't necessary. Half the ability to make an adjustment or repair is the ability to discover its necessity.

Have you ever noticed the motorist who seems "lucky" with his car, who



Inspect your engine systematically once a week. You will save money

never seems to have a bit of trouble, everything is neat and the engine always starts immediately the self starter is pressed? Who doesn't have any breakdowns while on the road, nor curse the manufacturer for building such a car? It isn't luck at all. With all adjustments properly taken care of, every bearing and working part lubricated, the whole car will run perfectly and will continue to run with only a wee bit of attention.

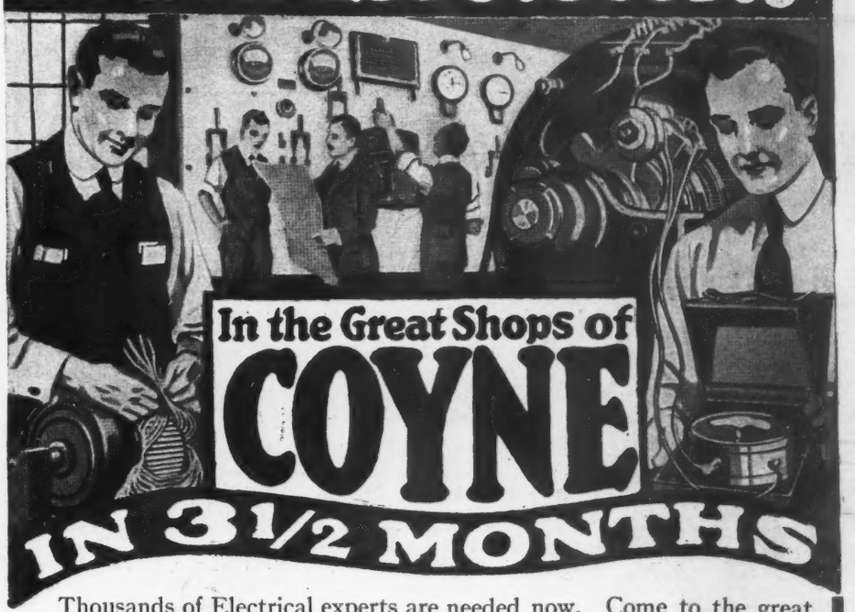
In neglecting details you save time and inconvenience to be sure but eventually you will find a bad break and what time you have saved will be wasted in expensive repairs.

Never push your car at high speed over any road, much less a rough or a slippery one. The slight gain in time will be offset by the risk of an accident and the pounding and racking which the car will receive.

It has been proven that the owner who drives his car at average speeds of from twenty-five to thirty-five miles an hour over all sorts of roads pays much more per mile for gasoline, oil and tires than the driver who watches constantly for rough places and avoids them and who drives at a rate of eighteen to twenty miles per hour. A car which is driven at a high rate of speed is usually in the repair shop often, which adds much more to the cost per mile of operation.

It is not how many miles are covered in a certain time, but the number of miles of useful travel that can be obtained at the least cost for fuel, oil, tires and repairs.

Learn Electricity



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Don't be a road hog. Of all pests this kind of driver is the worst. Observe the rules of the road. Have respect for those who are using the same highway. Remember that courtesy and consideration to others will always win you the same.

The very best method of using the brakes is that which applies pressure to them so that the car gradually comes to a stop.

Coast whenever possible for this is another way of saving gasoline and tires.

Get rid of that idea of "showing off," and avoid spectacular stops. The practice is disgusting to everyone and there may come a time when, through constant "showing off," the brakes will fail, and then the doctor's advice won't help you any.

The careful driver shuts down the throttle before he reaches his stopping point, and allows the car to run on its momentum until he reaches the stopping point. Then he applies his brakes easily and comes to a perfect stop at the exact place where he intends to halt. Try these few suggestions and check up your car bill with the three months previous. You will never again stray from the economical pathway.—F. A. CUFFE.

A Celluloid Window for a Yacht Curtain

A SIMPLE device, which will be appreciated by all yachtsmen, who, in steering a motor-boat into the wind, must face the sting of the salt spray, is a celluloid window, placed in the curtain immediately in front of the helmsman's seat.

You can make your own automobile or yacht curtains by using this method.

There should be three of these windows, each about 5 in. by 8 in., equally spaced on the front of the curtain. The celluloid window-panes are bound with strong canvas, and then, by means of snap fasteners, just like ordinary glove snaps, these panes are attached to the curtain. The margin of the curtain about the window is made of a double layer of canvas so as to cover up the snaps and binding.

Occasionally, as the celluloid becomes encrusted with salt by evaporation of the salt water, the helmsman must reach around the side of the curtain and clean the window so that he is able to see ahead.

Such a window is a vast improvement over the usual type, which compels the raising of the curtain altogether and then fending off the driving spray with the uplifted arm.—FLOYD L. DARROW.

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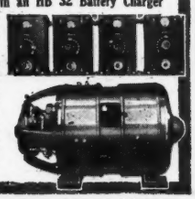

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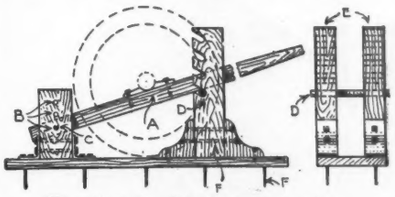
An Inexpensively Made Jack for the Automobile

THE illustration shows a simple and easily made lever jack for raising one of the rear driving wheels of an automobile and holding it steady by



The diagram shows how to make a good, inexpensive automobile jack

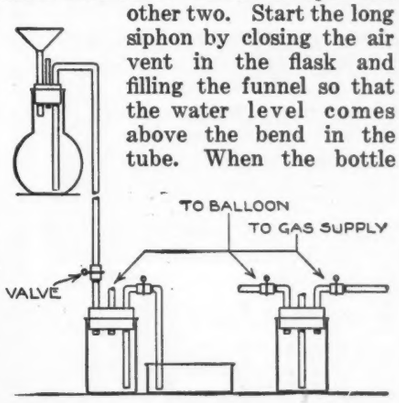
means of anchor pins, which sink into the ground, permitting the car to operate machinery driven by a belt from its rear wheel.

The jack is made of wood or light iron. The lever *A*, with the hole in its end, may be connected by the bolt *C* to any of the holes *B*. Fastened to the top of the lever is a half circle bearing for the automobile axle to rest upon. The pin *C* may be placed at any desired jog for elevating the machine.—JOHN D. LOWRY.

To Use Gas Under Pressure for Experimental Work

THIS gas pump may be used for filling miniature balloons, or in other operations where it is desired to use gas under pressure in a small quantity. The pressure is only limited by the head of water that can be obtained. The diagram explains the construction clearly.

To start the apparatus, fill the flask with water through the funnel and also fill the bottle. Turn on the gas and open the valve in the short siphon. This will fill the bottle with gas. Close both these valves and open the other two. Start the long siphon by closing the air vent in the flask and filling the funnel so that the water level comes above the bend in the tube. When the bottle



Toy balloons and miniature dirigibles may be inflated with the contrivance

is full shut off the valve to the balloon, and also the one to the long siphon. The operation is repeated until the required amount of gas has been forced into the balloon. Of course it will be only necessary to start the siphon once, as after that it will be full of water.—GEORGE CAREY.

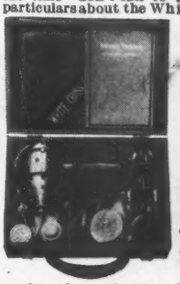
Here's Health and Power Vim and Vigor

ALL men—and all women, too,—wish these marks of good health. If you feel you haven't them, you should write for book, "Health and Beauty." Read it! Then make up your mind whether you think that the White Cross Electric Vibrator can bring to you these vital signals of health. You will read in this book and in other literature we will send, what several hundred people have found out about vibration and what it has done for them.

THE WHITE CROSS ELECTRIC VIBRATOR

All the Exhilarating Joys of Life—Strength—Youth

Do you feel just right? If you do not—if you haven't that vigorous "go ahead" feeling all the time—don't fail to send the coupon for full particulars about the White Cross Electric Vibrator. **In vibration** there exist many of the secrets of life. You now have an opportunity of seeing what vibration will do for you and how every nerve, every fiber—your whole body will fairly tingle. With our Combination Outfits, you may give yourself Swedish Movement, Vibrating Chair Treatments, Facial Massage, Faradic or Galvanic Treatments—right in your own home.



The White Cross Electric Vibrator is the result of years of work and experiment. If you have your house wired for electricity, you connect it up as easily as an electric lamp; if not, we can supply you with models operated on their own batteries.

Nature's Aid to Beauty

Beauty can not stay long where health does not rule supreme. It may be only a slight illness that is the cause for a muddy complexion, dull eyes, or unsightly blemishes. Thousands have found that vibration corrected these illnesses—and beauty resulted. Read the stories in our free booklet.

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Get our big FREE book "Health and Beauty." Tells all about the marvels of vibration. Send coupon *today.*

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"When I got into the shop myself I noticed the toolmakers and everybody who had 'fussy' jobs preferred Starrett Tools.

"There's something about 'em that the fellows like. Yeh! They're accurate and they're convenient, but I guess the fact that the men who make 'em are pretty good mechanics themselves, has something to do with it.

"What? Sure I'm getting me a set of Starrett Tools—I need 'em every day. Yes, I got me one of those seventy-five cent Starrett Apprentice Books, too. It saves me asking the foreman a question every five minutes. Now, when I want to know how to do something, I can look in the book and study it out myself."

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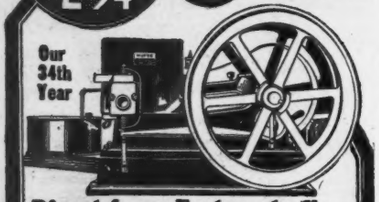

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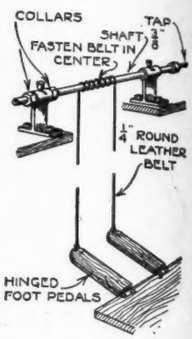
How to Make a Foot-Power Reversing Tap

WHEN there are a large number of small parts, such as small die castings or punchings, to be tapped and threaded, and they do not require more than 5 or 6 threads, the arrangement shown in the illustration may be successfully used if a reversing power tap is not available.

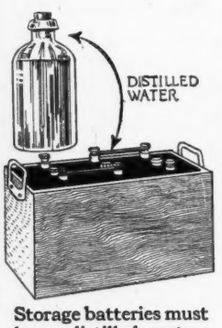
A shaft is mounted upon two bearings and a hole cut through the bench to allow two small belts to run down to the two foot pedals. The tap is mounted on the end of the shaft in a chuck or other suitable holder. In operation, the piece is held to the tap, and one pedal is pressed. This causes the shaft to revolve, thereby tapping the hole. Then the other pedal is pressed and the shaft makes the required number of revolutions in the opposite direction to run the tap out again.—VICTOR H. TODD.



One pedal runs the tap into the hole, the other revolves it out again

Why Distilled Water is Used for Batteries

A GOOD deal of ignorance is abroad as to why nothing but distilled water should be used in storage cells. All water but distilled water contains mineral matter in solution, and although this may be small in quantity, as the water evaporates the mineral matter is left behind and all that ever enters the cell remains there. It is obvious, therefore, that the amount of mineral matter in solution constantly increases. Very soon the concentration becomes so great that the mineral salts are deposited on the plates of the cells. Electrolytic action then begins between the salts and the plates, with the result that the framework of the plates is eaten away and the life of the cell destroyed. The energy wasted in the process, too, is considerable.



Storage batteries must have distilled water; otherwise the plates will be eaten away

Some people have the idea that boiling the water helps, but boiled water is worse than unboiled, for in the boiling the concentration of mineral matter in solution is only increased. Therefore, avoid the use of any but pure distilled water in filling storage cells.—FLOYD L. DARROW.

The Time to Know Output

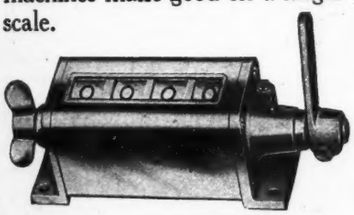
When a run of work is finished, you can check up on your machine's speed by counting the product by hand—but *too late* to improve the rate-of-work on that run.

A Veeder Counter on your machine will record the output *as the machine works*, so the highest possible production-rate can be maintained without a let-up.

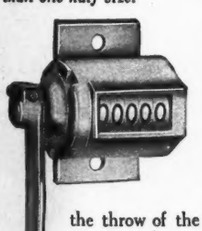
The difference between a haphazard production-rate and the attainable *standard* is always great enough to make

Veeder
COUNTERS

necessary equipment in making machines make good on a larger scale.



The above Revolution Set-Back Counter records the output of any machine where a shaft-revolution indicates an operation. Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $8.50 (List). *Cut less than one half size.*



The Number 14 **Ratchet Counter** at left registers one for each throw of the lever, recording number of machine-operations. Supplied with outside stops which regulate the throw of the lever, and having return spring action which automatically returns the lever into position for the next count. The lever is adjustable, allowing the counter to be used at any angle. Price, $2.00. *Cut nearly full size.*

Most any machine you're interested in can be equipped with a Veeder Counter; the Veeder booklet shows the many styles and sizes. Copy on request.

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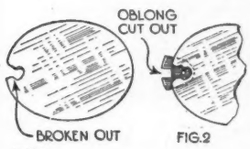
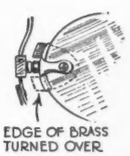
An Emergency Repair for Eyeglasses

OWING to a broken lens in a pair of prescription glasses a local commuter contemplated a long railroad ride in the morning, minus the usual newspaper.

The break (Fig. 1) was of such a nature that but little cement-holding surface was present. However, the trouble was overcome with a piece of sheet brass as follows:

Cutting a piece of thin brass sheeting in the shape shown in Fig. 2, so as to allow it to project somewhat beyond





A thin piece of brass makes an emergency repair for eyeglasses

the shoulder of the clamp, a hole was bored for the screw. Applying cement to the brass, the lens was put in place and the brass carefully slid into position, a portion of the edges being under the screw holding the clamp. Tightening the screw forced the cement to take an even hold on the lens. Turning over the edges of the brass as in Fig. 3 made the repair complete.—JAMES M. KANE.

How to Place Electric Lights in Candlesticks

IT is not an easy task to drill through silver or china candlesticks in order to permit a wire to pass through; indeed, one runs a chance of destroying the candlestick if he attempts to do so.

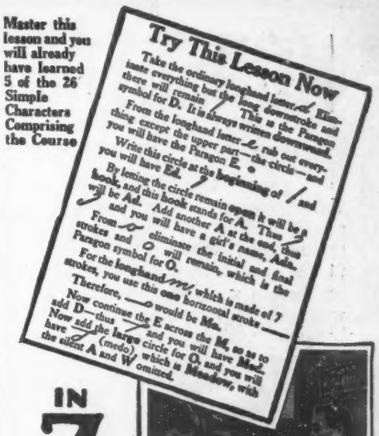
I have been very successful in placing electric lights in candlesticks by the use of the little fixture described in the ensuing paragraphs.

A piece of ⅛-in. brass pipe is threaded on one end to fit the socket, and a hole drilled in one side permits the wire to be passed through. The sheet brass, which is of thin gage, is soldered to the pipe.

A hole is punched through an ordinary large rubber stopper and slipped over the pipe. This not only holds the fixture in the candlestick, but also acts as an insulator.

The sockets I have been using are for lamps with candelabrum base, and the bulbs 15-watt. Regular sockets and bulbs may be used just as well. The wiring runs along the back of the dresser and down to a plug in the floor or baseboard. If the fixture and sockets are nickeled it adds very much to their beauty and attractiveness. —HARVEY MEAD.

Master this lesson and you will already have learned 5 of the 26 Simple Characters Comprising the Course



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(Pop. Science 10-19)

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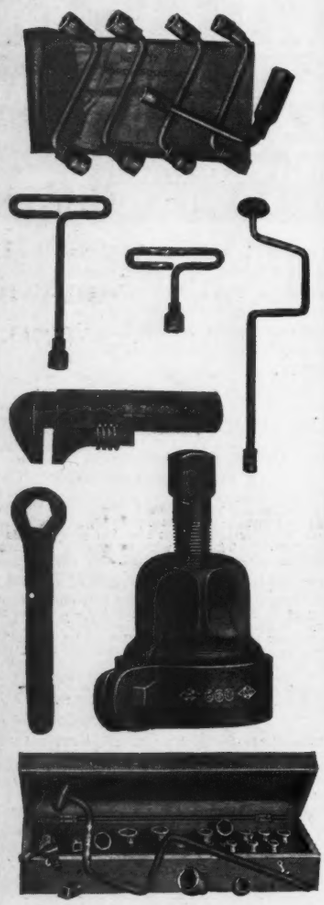

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Making a Waterbox Noiseless with Rubber Hose

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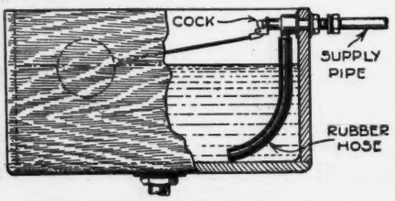
This noise may be easily eliminated by placing a piece of rubber garden



The rubber pipe absorbs all the noise and makes the box noiseless

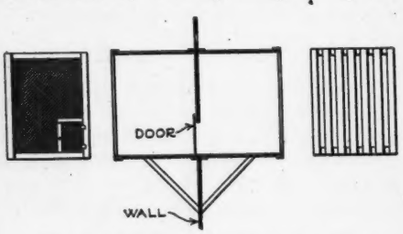
hose between the nozzle of the faucet and the bottom of the box. This allows the water to enter into the waterbox below the surface of the water, and thus completely eliminates the noise.—VICTOR H. TOPP.

Adaptable Break-up Coops for Poultry

THE combination indoor and outdoor breaking-up system is an excellent one. Both coops, one inside and one outside the poultry house, are of the slat bottom type, about 2 ft. wide, 3 ft. long, and 3 ft. high, the top and sides being of hen wire. These coops are attached to the rear house wall about 4 ft. from the ground. They are connected with each other by an aperture in the wall a foot square, closed from the side with a board slide. The season of the year and weather conditions determine how this breaking-up equipment is handled.

In stormy weather the year around, and through the winter, the inside coop alone is used. Through the warm months, in pleasant weather, the outside coop is the favorite. Sometimes broody hens are kept in the outside coop days and the inside coop nights.

"I adopted the outside coop," says the inventor, "chiefly to speed up the



The poultry appreciate being indoors when it rains exactly as much as you do

breaking-up process in warm weather, when the temperature of the poultry pen rose so high that the brooding fever persisted in hens even when placed on slats. Ordinarily, of course, the slat bottom, allowing cold air to strike the hen's body from beneath, would check the fever. In warm weather, I consider the outside coop twice as efficient in breaking-up as the inside one.—J. T. BARTLETT.

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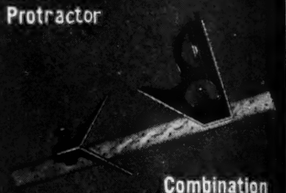

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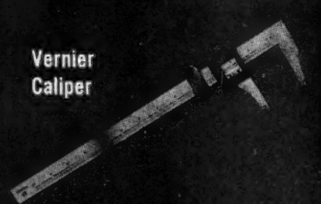

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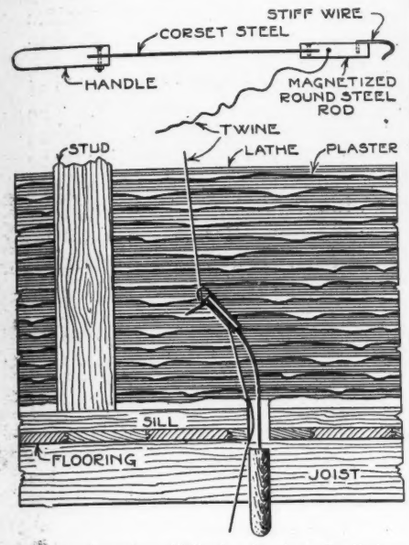
A Magnetic "Fishing" Tool for Locating Blind Wiring

IN wiring old buildings it is the custom to install the wires, covered with an insulating tubing called "loom," in the partitions and ceilings without disturbing the exterior, whenever possible.

This practice is called "fishing" by the electrical trade. It consists of

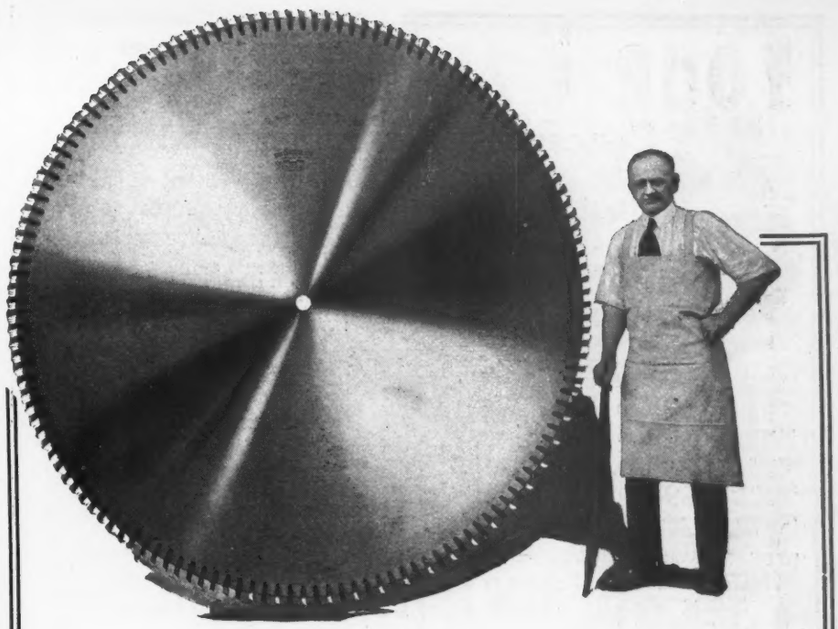


This tool makes "blind wire hunting" less tedious and more positive, requiring less time

having a helper dangle a line, on the end of which is fastened a nail or other weight, inside the partitions, from an opening cut or bored in the header of the partition, from the room above, or from the switch outlet hole in the same room as the partition, as the case may be.

The wireman goes into the cellar, if the partition is on the first floor, and bores as many holes close together as there are wires to enter the partition, upward through the flooring, the sill or bottom plate of the partition, and the layer of plaster always found there. He then proceeds to take a short length of wire, with a hook on one end, and, after inserting it into one of the holes, he twists it around and around until he catches the line the helper is jiggling from above. This is usually a tedious operation, and it is pure luck to a great extent.

The tool shown in the illustration is intended to make this "fishing" process less tedious and more positive in operation. The construction is made clear and all parts are labeled. It consists, essentially, of a length of round steel rod about 3 in. long and ⅜ in. in diameter, which is strongly magnetized to form a bar magnet. One end is slotted to take the corset steel forming the flexible handle and is held in place by a machine-screw passing through the rod and steel. At the other end a stiff wire hook is threaded into the rod from the side, and bent as shown. A hole is also provided in the rod through which a strong piece of twine is threaded and



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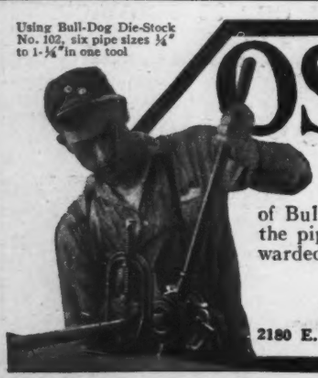

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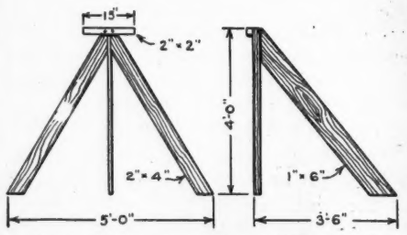
fastened. The other end of the corset steel is fastened to a wooden handle made from a length of broom-stick.

The manner of using the tool is clearly depicted. It is inserted through the hole from below, as previously mentioned, and then the cord attached to the rod or magnet is pulled taut to bend the corset steel. The entire tool is revolved in the partition. As soon as the magnet strikes the nail it will stick to it, the contact being felt by the helper, who immediately notifies the wireman in the cellar that connection is made.

This tool will pay for the trouble of making it on its very first job. The tool must be small enough to insert through a 1-1/16 in. hole as this is the size bit used exclusively in knob and tube wiring.—J. A. WEAVER.

How to Make an Inexpensive Saw-Filing Tripod

AMONG the problems that worry the carpenter, is that of getting a good light for filing his saws, and a convenient position to file them in. If he fastens his clamp to a window opening, he is dependent upon the sun and the weather. If he has it on his work-bench, the light is usually far from being what it should. And saws that are properly filed determine very largely both the quality of the work and the ease and enjoyment of working.



With the contrivance shown the saw may be operated upon in the best possible light

The tripod shown in the illustration overcomes these various difficulties. It is inexpensive to make, and the carpenter who once uses it will never go back to the old way.

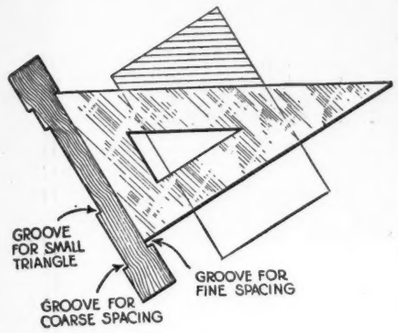
The device consists of two pieces of 2 by 4 timber, opposed to each other, and grasping between them at their upper ends a piece of 1 by 6, slanting sharply to the rear. On the square, 12 and 24 give the plumb and level cuts for the 2 by 4's, and 12 and 16 for the 1 by 6. The height depends upon the stature and filing habits of the workman, but 4 ft. may be taken as the standard height for the edge of the saw from the floor.

To put the tripod together, nail the 1 by 6 to one 2 by 4. Then toenail the other 2 by 4 into place and put one big spike through all three pieces. Cut about an inch and a half off the pointed top of the tripod.

The device by which the clamp is attached depends, of course, upon the type of clamp used.—HENRY SIMON.

Speeding Up the Tedious Process of Section Lining

THE simple device shown in the illustration can very easily be made and will increase the speed and accuracy of section lining. A thin strip of soft wood or a piece of celluloid, such as is used by draftsmen for



This ingenious device increases the speed and accuracy of line drawing

making templates, is notched 1/16 in. longer than the short edge of the triangle to be used. This groove may be made longer for broad spacing of the lines or shorter for fine work.

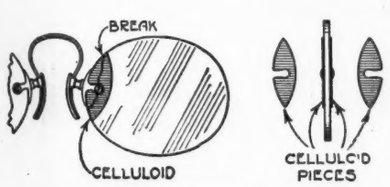
In use the strip is brought against the edge of the triangle with the left hand, and the strip and triangle moved alternately after drawing each line. This gives a uniform spacing not obtainable by free-hand methods.

The other long edge of the guide strip may be grooved for another spacing of the lines, or in order to use a smaller triangle.—E. EARL GLASS.

You Can Repair that Eyeglass with Celluloid

ONE day, when adjusting my eyeglasses, they fell to the floor and were broken, leaving a portion of the lens in the clamp. I did not wish to have the lens reground, so I decided to try and mend the broken lens myself. Cementing the two sections together, I laid the glasses away until the cement had thoroughly set.

To insure against another break in the same place, I cut two pieces of celluloid out of a section of a broken



Glasses are usually broken unexpectedly. Here's a way to fix them temporarily

automobile window and cemented them against either side of the broken portion of the lens. This method of effecting a repair was very neat, owing to the transparency of the celluloid, and makes the repaired portion exceedingly strong—JAMES P. KANE.

Sargent Auto-Set Bench Plane

Cuts fast
Cuts true

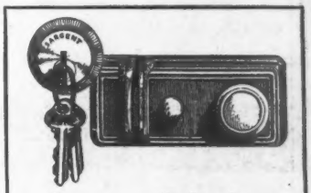
"VERY handy feature," said a master carpenter as he glanced at the new Auto-Set Adjustment. Picking up the plane, he tried it in practical use. "That's a mighty good plane," was his verdict.

That exactly describes the Sargent Auto-Set:—a dependable tool, with a big improvement added to save time and trouble.

The cap iron and clamp are fitted together as one piece, with a set-screw to regulate the position. Another set screw adjusts the cutter.

May be taken down for whetting in a few seconds and assembled as quickly. Cutter and cap iron go back into exactly the same position as before.

Made in six sizes; smooth or corrugated bottom; fore, jack, smooth or jointer patterns. Descriptive booklet on request.



Sargent Cylinder Day and Night Latch

Put it on doors—inside and outside, front and back—that you want securely barred. An ordinary mortise lock is "easy pickings," but a cylinder latch keeps the intruder outside. "Press the button" to dead lock the bolt or hold it back, as desired. "Pull the button" to release the bolt. Self-locking—closing the door springs the latch.

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WIRE electrical, rope, airplane, piano, pipe-organ, flat, hoops, bale-ties, tacks, nails, barbed-wire, concrete re-inforcement, springs, netting, wire fences, steel posts, trolley-road wires and rail bonds, wire wheels, auto-towing cables, horse-shoes.

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will solve any problem in addition, subtraction, multiplication, division and proportion. A Log-Log scale gives any root or power of any number. Gives Logarithms, Sines, Tangents, Cosines, Cotangents and the decimal equivalents of fractions to six decimals. It is grease and water proof and will give years of service. This rule is not to be compared with the paper utility rules which sell for $1.00 and are put together with paper fasteners. It is accurate, simple to operate and comparison shows that it is undoubtedly the fastest and most complete rule made. Our refund guarantee protects you from loss or disappointment. An instruction book, 16 pages, 12 illustrations, is sent with each rule. Diameter 4 inches. Made in two models. Metal (white coated steel) $1.00. White Celluloid, $1.25. Leather Case, 50c. extra. Your money back if you are not satisfied. Send for Catalogue of Slide Rules.

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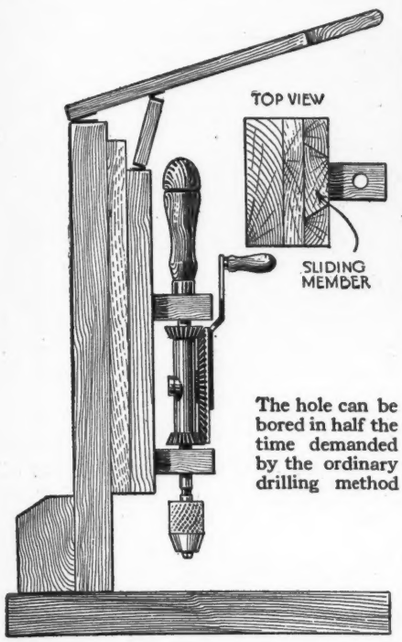
Apply at any Navy recruiting station; select the branch of service you like; pass the necessary examination. Your pay begins the day you join.

NAVY DEPARTMENT · UNITED STATES OF AMERICA

Transforming a Drill into a Drill-Press

A SMALL drill with a three-jaw chuck can be made into a serviceable drill-press with the aid of a stand and proper supports. As there are so many different makes of hand drills on the market no detailed description can be given, but the drawing shows clearly the general



The hole can be bored in half the time demanded by the ordinary drilling method

construction. The lever enables a steady pressure to be applied with little effort. Hinges connect the different parts of the lever with the back of the stand and with the sliding member which holds the drill proper. The upper part of the drawing shows the way in which the sliding member is held in place. If a little candle wax is placed on all sliding surfaces it will work very much easier. A stand like this will prevent a lot of broken drills.—M. K. GORDON, JR.

Don't Let that Chimney Become Clogged Up

SHORTLY, now, the furnace will go into action again, and then comes the problem of removing soot from the chimney. Every week or two, as needed, spread out on the cellar floor six or eight sheets of newspaper and sprinkle them generously with kerosene oil. Then wrap them all up into a bundle and shove them into the fire-pit of the furnace with all drafts open, and shut the door. Light the papers and all the soot will be burnt out of the pipes and chimney, leaving them perfectly clean. In using this method the furnace pipe will, if very dirty become cherry red, and large pieces of burning soot will emerge from the top of chimney. For this reason it is best to do this work on a rainy day to be safe from any possible fire.—G. H. DAVIS.

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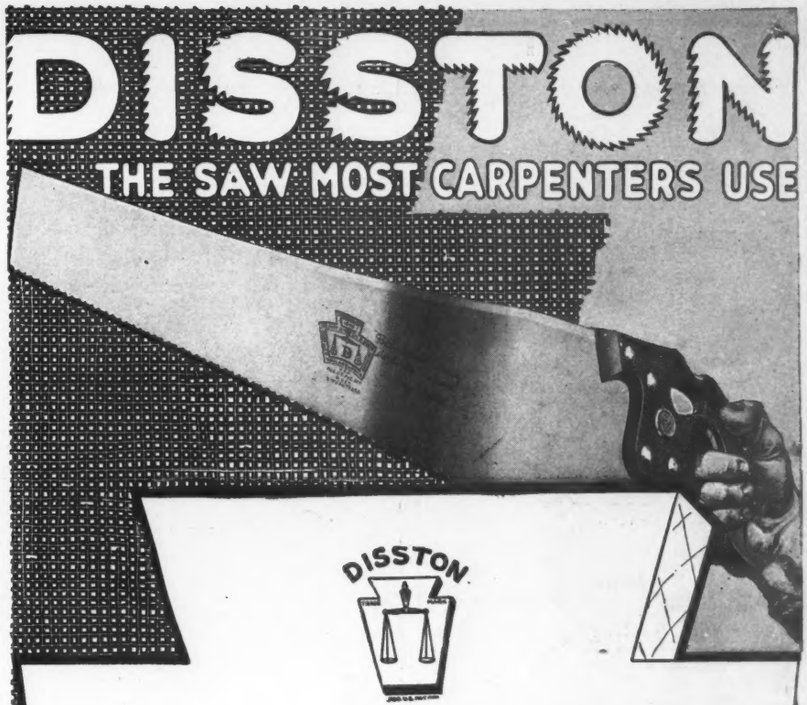

Everywhere in the world Disston Hand Saws are accepted as the highest standard; for in saws, as in everything else quality and durability are soon recognized. All steel used in making Disston Saws is Disston Crucible Steel—specially made in the Disston Plant.

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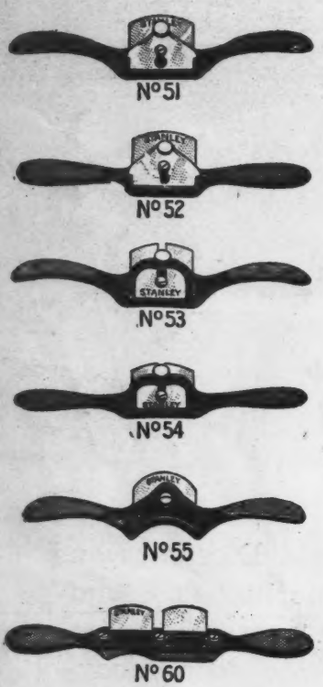

"BAILEY"

Iron Spoke Shaves

Only a few of the numbers manufactured are shown in the illustration. The cutters of all numbers are made from a high-grade of steel, well tempered and ready for use.

Made with two styles of Handles, raised and straight, and through each a hole is made, so that when not in use the tool may be hung up out of the way.

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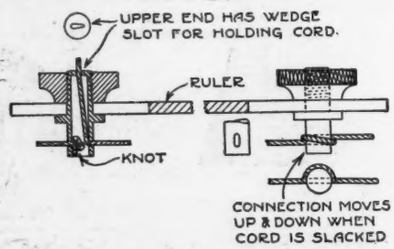
For the Home Draftsman

By G. A. Luers

THE usual folding table lid desk is very well adapted for drafting purposes, but its convenience and utility can be very greatly enhanced by converting the lid into a first-class drawing board and adding a self-alining parallel ruler as a permanent fixture.

The method of doing this involves comparatively little work and, as is shown in the accompanying drawings, the alteration is invisible when the desk is closed.

Four small rollers are required. These are made from metal disks with holes bored through the centers, and grooved to carry a cord, which



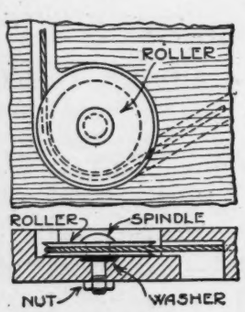
The diagram shows exactly why the ruler is always in perfect alinement

maintains the parallel action of the ruler.

The straight-edge is provided with lengthwise slots at each end, for angular movement, when the nature of the drawing necessitates other than horizontal lines.

It appears as an ordinary writing desk when the cover is shut

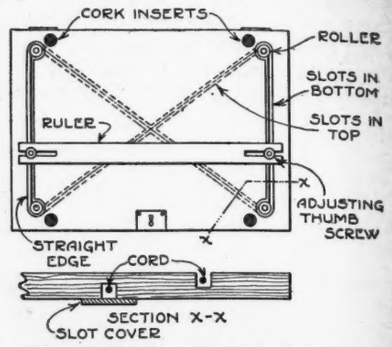
Four metal spindles, washers and nuts, on which the rollers revolve, are needed for fastening these to the drawing board or desk lid. Two adjustable thumb-screws for securing the straight-edge to the alining-cord, provide means of detaching the ruler and shifting it from the horizontal position.



The pulleys permit the cords to aline the straight-edge

The upper face of the board is drilled part of the way through at each corner, to accommodate the roller slots across the board on the upper side. Connect these bored holes and provide a recess for the cord to slide in. On the under side of the board diagonal grooves are cut, which open at the ends into the roller recesses. The cord slides through these channels.

Diagonal cross-pieces are made to



Here is the layout of the system of pulleys which alines the straight-edge

be screwed over these openings when the cord is in place, concealing and protecting them. The cross-pieces should be made of some pleasantly contrasting wood.

When the desk lid is of hard wood, four holes should be drilled at the corners for inserting corks or soft pieces of wood, into which thumb-tacks are pushed when attaching the paper.

The Proper Care of Electric Motor Brushes

ON all electrical machines, the brushes on a stud must aline properly with each other, and with the commutator bar from front to back of the commutator. An accurate method of spacing the brushes is to place a strip of paper tape around the outer edge of the commutator and mark the paper where the ends overlap. After removing the tape, divide it with a pair of compasses, or a scale, into as many parts as there are poles upon the machine. Then replace the tape around the commutator, pasting the overlapping ends together. The brushes are then set and spaced by the marks on the paper, care being taken that the brush-holders are clamped to the stud in the proper position.

After being spaced, the brushes are fitted to the commutator. In doing this, a strip of sandpaper is passed between the commutator and brush face, coarse paper being used first to obtain an approximate fit, followed by a very fine paper, which gives a close and accurate fit. When sandpapering brushes, the sandpaper should be held close to the commutator to prevent rounding the tip of the brush when drawing the paper away. It should be withdrawn in the direction of rotation.

After sandpapering, the resulting carbon dust should be blown away from the armature, the air being directed away from the rotating part, so that the carbon dust does not drift into the windings.—J. WILLIARD HERSHEY.